INTEL Vs. AMD: CHIP WARS

What's the best processor for your budget right now? **PG. 26**

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Gaming doesn't have to cost a fortune **PG. 66**

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Vivid closed-loop CPU cooling with the Raijintek Triton AIO **PG. 78**

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Build 3D multi-platform games for free with Unity **PG. 60**

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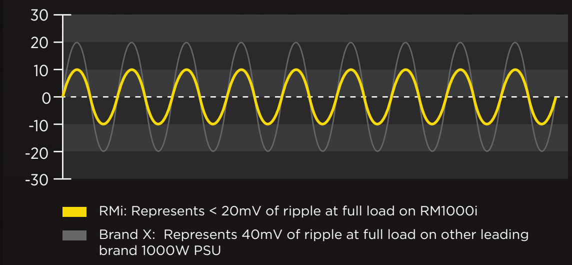

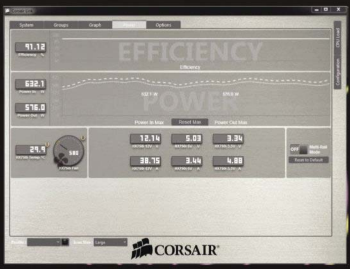
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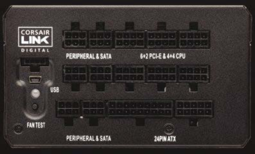
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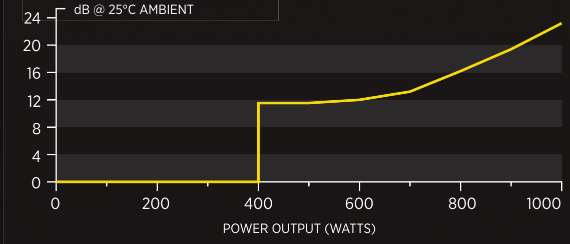

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inside

AUGUST 2015

CPU SUPERTEST 26

26
PROCESSOR SUPERTEST
Is now the time to upgrade? We've put six top CPUs through their paces to find the best processor for gaming.

42
WINDOWS 10: FULL PREVIEW
With DirectX 12, a new web browser, and universal apps, will Microsoft's new OS be the return to form we're craving?

50
THE FUTURE OF GAME MODDING
Delve into the past, present, and future of game modding, with this special report, in light of Steam's paid-mods debacle.

QUICKSTART

12 **THE NEWS**
Windows as a service; Linksys unveils first router with MU-MIMO tech; Fixstars breaks record with 6TB SSD.

18 **THE LIST**
Seven games that changed graphics.

20 **TALKING TECH**
AMD reveals why we should be excited about its new notebook APU, Carrizo.

Where's a shotgun when you need one?

R&D

58 **AUTOPSY**
We take a toolbox to the Apple Watch.

60 **HOW TO**
Develop a 3D game with Unity; give your photos a vintage look; keep your PC secure with Heimdal.

66 **BUILD IT**
We rein in the budget and attempt to create a sub-$500 gaming PC.

LETTERS

22 **DOCTOR**

94 **COMMENTS**

IN THE LAB

72 **DELL XPS 13**

74 **VIEWSONIC VP2780-4K**

80 **AUDIO-TECHNICA ATH-PDG1**

86 ***THE WITCHER 3: WILD HUNT***

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Tuan
Nguyen

TECH WILL KEEP EVOLVING, AND SO MUST WE

THIS YEAR is a very special year for PC and PC gaming enthusiasts. There are things on the horizon that are poised to break new ground on the hardware scene. Take, for example, VR. It's coming out at the consumer level toward the end of the year, and there's no doubt that things will get interesting. But even more important is what's coming in the near term.

Microsoft has been grilled in the last year by the community for forgetting its roots, the desktop PC. On several occasions, it's even said that it would go back to caring about PC gaming, but that hasn't happened—until now. Enter DirectX 12. Regarded as the savior of gaming on the desktop, DirectX 12 is supposed to bring low-level GPU access to the application layer. This isn't new, however. AMD's Mantle driver provides the same benefits and performance. Unfortunately, AMD isn't pushing Mantle now, and instead is actually encouraging developers to go with DirectX 12.

Beyond performance gains, there's word on the street that DirectX 12 also allows you to use multiple GPUs from different birth parents. That's right. Imagine pairing up an AMD card with an Nvidia card and getting double the performance. That seems like a pipedream to us, to be honest. Can you say "driver hell?"

On the CPU side, Intel is out with Broadwell, but by the time you read this, Skylake may already be on the market. This is an unusual release schedule for Intel because Broadwell is technically a year late, and Skylake is a "tock" on Intel's release schedule. However, for us, Skylake is much more exciting than Broadwell. It represents a new architecture with such salivating features as PCI Express 4.0, native SATA Express, and up to 128MB of L4 cache on some models.

The release timeframe for Skylake is interesting, as it aligns closely with the availability of consumer-ready VR products from companies like Valve. Oculus isn't far off, either, announcing that the consumer version of the Rift will be available in early 2016. Having PCI Express 4.0 means we can expect a host of new GPUs, and a host of new GPUs is perfect for VR. We're excited.

Speaking of excitement, I'm thrilled to say that www.maximumpc.com has a fresh new look. The way it's designed is to shine the limelight on the best content—the content we think is most interesting or valuable for you. We've come a long way, and now that the site is live, we're back to doing what we do best: benchmarking the hell out of the latest gear in the ongoing pursuit of PC nirvana.

Tuan Nguyen is Maximum PC*'s editor-in-chief, also known as "the pointy end of the stick." He's been writing, marketing, and raising hell in the tech industry for 19 years.*

↘ submit your questions to: comments@maximumpc.com

THE NEWS

Windows Reboots as Ongoing Service

Could Microsoft be moving toward a subscription model?

THE PATH to Windows 10 has been riddled with unexpected twists and turns. Even the name came as a surprise—while most assumed the successor to Windows 8/8.1 would be called Windows 9, Microsoft decided, at least publicly, that the next version of its OS would be such a generational leap forward that it warranted skipping over Windows 9. Conspiracy theorists still point to other explanations, such as lazy coding, but that's not the point.

One thing we've come to realize about Windows 10, now confirmed as being made available for PCs and tablets from 29 July, is that we should expect the unexpected. Toward that end, Microsoft's second major surprise came when the company announced free upgrades to Windows 10 for existing Win7 and Win8.1 users for the first year. That's where things get truly interesting.

More recently, a Microsoft employee made a shocking statement about Windows 10 being Microsoft's endgame.

"Right now we're releasing Windows 10, and because Windows 10 is the last version of Windows, we're all still working on Windows 10," Jerry Nixon, a Microsoft development executive, said at Microsoft's Ignite conference in Chicago.

Don't mistake that to mean Microsoft is throwing in the towel. It's doing nothing of the sort. Instead, Nixon's referring to Win10 being the beginning of Windows as a service. It's a move many suspected Microsoft was working toward, though without an explanation as to what Windows as a service means in Microsoft's eyes and how it will affect customers. Understandably, there's some hesitation by Windows users to embrace the change.

One of the fears is that Microsoft is prepping a subscription model, much like Office 365. You pay a monthly fee and in return you're allowed to use the OS and receive feature updates as they're doled out. Those who believe Microsoft is going in that direction point to early announcements that Windows 10 would be a free upgrade for the first year. If it's free for a year, then that must mean a subscription price kicks in afterward, right?

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Windows 10
Satya Nadella

Microsoft still hasn't fully clarified its Windows-as-a-service strategy.

Only clues, not answers, are available. Microsoft's director of program management, Jim Alkove, stated in January: "Once a Windows device is upgraded to Windows 10, we will continue to keep it current via Windows Update for the supported lifetime of the device, at no cost. We think of this as Windows as a service."

The way Alkove explains it, Win10 devices will continually benefit from new features, functionality, and security updates, at least until Microsoft determines your device is obsolete (details on Microsoft's supported lifetime policy have yet to be announced). If so, the only time you'd need to purchase a Windows license will be when buying or building a new system.

Microsoft confirmed this approach with its release date statement, in early June. Win7 and 8.1 users will have a year to claim a free upgrade, after which it will be updated, for free, for the life of the device. There is still no word, however, on costs beyond the life of the device, or for new devices.

Microsoft CFO Amy Hood added more insight during a shareholder meeting. She explained that Microsoft already gives Windows licenses away to manufacturers of sub-9-inch devices, and that the strategy is to chase revenue from Bing search, apps, and cloud-based subscription services that tie into Windows 10. Of all the ways Microsoft intends to generate revenue, Hood made no mention of a Windows subscription. **–PL**

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First Wireless-AC router with MU-MIMO technology.

LINKSYS UNVEILS BLAZING FAST WI-FI ROUTER

THERE ARE ROUTERS on the market that claim they're MU-MIMO-ready, but to the best of our knowledge, all of them are still waiting on official firmware to support the feature. That's not the case with the Linksys EA8500 ($280 MSRP)—it's ready to go right out of the box.

Supporting MU-MIMO is an important part of the evolution of routers. According to Linksys, the average home now has more than eight connected devices. The router you're using now can only accommodate one of those devices at a time, meaning all the others have to get in line. You might not notice it much, if at all, because single-user MIMO routers are fast, they're just not as speedy or efficient as MU-MIMO-enabled routers. One place you might notice this is when streaming videos—frequent buffers could be the result of a congested network.

By way of MU-MIMO, the EA8500 can dish out bandwidth to all of your devices at once—it's like they're all connected to their own router, provided your devices also support MU-MIMO. If not, well, we suppose the EA8500 amounts to future-proofing your home network, at least to the extent that home networks can be future-proofed.

Linksys rates the EA8500 as an AC2600 router, though as we always feel the need to point out, the rating is a bit of marketing fluff because it combines the speeds of the 2.4GHz and 5GHz frequencies—up to 800Mb/s on the 2.4GHz channel and up to 1,733Mb/s on 5GHz, or 2,533Mb/s. Apparently, that rounds up to AC2600, but aside from that, you can't combine the total bandwidth of both channels. We're not picking on Linksys here, as all router makers have adopted this way of marketing their devices.

Other specs and features include a 1.4GHz dual-core CPU, beamforming support, four removable external antennas, four Gigabit ports, USB 3.0 port, and a combo USB 2.0/eSATA port for cloud streaming and sharing data across a network. **–PL**

OCULUS RIFT'S BIG DEMANDS

HEAVY REQUIREMENTS MEAN AGING SYSTEMS NEED NOT APPLY

THERE'S A LOT OF RAW RENDERING needed for Oculus Rift to work its magic, as it runs at 2160x1200 at 90Hz split over dual displays. That equates to 233 million pixels per second, versus a traditional 1080p game at 60Hz that requires 124 million shaded pixels per second.

In order to pull that off and play games on Oculus Rift, the company recommends that you have an Intel Core i5-4590, or faster, processor, at least an Nvidia GeForce GTX 970 or AMD Radeon R9 290 graphics card, and no less than 8GB of RAM. In addition, you'll need Windows 7 SP1 or newer, a pair of USB 3.0 ports, and HDMI 1.3 video output. In other words, a well-equipped PC. **–PL**

FIXSTARS FLEXES ITS 6TB SSD

One step closer to hard-drive obsolescence

FIXSTARS Speed up your Business
SATA 6Gbps Solid State Drive
6TB
Fixstars NVM Solutions
SSD-6000M

JAPANESE FIRM FIXSTARS may not be a familiar name in the storage space, but it's doing everything it possibly can to change that. In February, it introduced the 3TB SSD-3000M in the United States, claiming it to be the world's highest-capacity 2.5-inch SATA SSD. But the SSD-3000M is no longer the highest-capacity drive even in the company's own lineup, let alone in the world. That honor now belongs to the SSD-6000M.

The SSD-6000M is a 6TB monster. Like the 1TB 1000M and the 3TB 3000M, it too is a 2.5-inch SATA III offering that uses the company's proprietary SSD controller. However, unlike both those drives, it uses 15nm MLC NAND and not 19nm MLC NAND. It boasts read and write speeds of 540MB/s and 520MB/s, respectively. **–PC**

Tech Tragedies and Triumphs

A monthly snapshot of what's up and down in tech

TRIUMPHS	TRAGEDIES
+ **NET NEUTRALITY MARCHES ON** The FCC wasn't moved by a petition filed by US cable companies and telecoms seeking to delay new neutrality rules. Good try, though!	– **LENOVO GOOFS UP** Lenovo apologized after posting pics of its LaVie Z 360 in Tent and Stand modes, neither of which it supports with full screen rotation.
+ **AMD SHARPENS SHEARS** AMD revealed new 7000 Series APUs for mobile systems, plus cut prices for existing A-Series desktop APUs.	– **NO WIN10 PREVIEW FOR YOU!** Microsoft told early Surface 3 owners not to install the Windows 10 Preview because Intel hadn't yet released Atom x5/x7 CPU drivers.
+ **MORE OF MOORE'S LAW** Gordon Moore predicted the shrinking of computer circuits will continue at the current pace for at least another five to 10 years.	– **R.I.P. MEDIA CENTER** Like Old Yeller, Microsoft decided it's time to put Windows Media Player down. It won't be in Win10.

Tom Halfhill

FAST FORWARD

Coming Down to Earth From the Cloud

MAY YOU NEVER KNOW the agony of losing vital data files. Some people have been driven nearly to suicide when their only working copy of an unpublished novel, dissertation, business plan, or photo archive has been lost.

The cloud shouldn't be the one Chosen One when backing up.

It may have been corrupted by a failing hard drive, maliciously encrypted by ransomware, or destroyed by a fire or natural disaster. For some victims, hard-drive recovery services are the last resort, no matter the high cost.

With so many cloud-storage providers these days, it's tempting to think we've entered a heavenly age in which we no longer need to maintain local backups. Just upload the stuff to a remote server and rely on the data-center angels to keep it safe. Unfortunately, the cloud's lining isn't always silver.

One problem is that cloud providers occasionally evaporate. A few years ago, some professional photographers lost their life's work when a cloud service went bankrupt so suddenly that there wasn't time to save the thousands of high-resolution files. That danger can be avoided by using the cloud storage now offered by large, stable companies like Amazon, Apple, Google, and Microsoft.

Another strategy is to store your files in multiple clouds. It's more trouble, but most providers offer a few gigabytes for free, so it's cost effective if your archive is relatively small. Nevertheless, local backups are still desirable. Some archives are so large that the initial upload would monopolize even a fast Internet connection for weeks. My largest archive contains thousands of scanned family photos and documents dating to the 1830s, and my personal photo archive is nearly as large and it's growing fast. Even the incremental updates can get unwieldy, especially after a busy day of scanning or photographing.

> “Cloud storage is no substitute for local backups, but remember, it's not really a backup unless it's stored offsite, not just a second hard drive in your PC.

Another problem is that many cloud services automatically synchronize all your files across all your connected devices. It's supposed to be a trendy feature, but it's a drag. I use different computers for my work and personal pursuits, and I don't want my business files and personal files shared on both. Nor do I want everything shared with a notebook, tablet, or smartphone that has less local storage and is more prone to loss or theft. Then too, automatic file sharing can clog a home Internet connection. Usually there are workarounds—Google Drive won't replicate files in subfolders—but some services are mysterious about defeating such features.

For these reasons, cloud storage is no substitute for local backups. The catch is you've got to be smart. Remember, it's not really a backup unless it's stored offsite. If your backup is a second hard drive in your PC, it's susceptible to all the same hazards that endanger the main drive, including power surges, spilled coffee, and ransomware. A disconnected portable hard drive stored in a desk drawer is slightly safer but is still subject to fires, floods, burglaries, or anything else that endangers your home.

My strategy is to rotate portable hard drives between my home office and safe-deposit box. Even this precaution may not save you from a major disaster like a flood, earthquake, hurricane, or whatever act of God afflicts your region. Periodically stashing a drive at a relative's or friend's house will preserve most of your valuable files. Of course, cloud storage is the ideal insurance against big calamities, but it shouldn't be your only backup.

Tom Halfhill was formerly a senior editor for *Byte* magazine and is now an analyst for *Microprocessor Report*.

CyberPower recommends Windows.

AMD

AMD RADEON GRAPHICS

AMD FX UNLOCKED

AMD A SERIES

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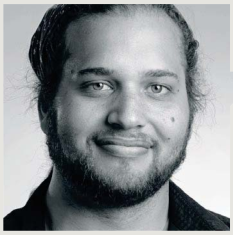


Alex Campbell

OPEN SOURCE

Penguin or the Egg (Pt 2)

WE DON'T YET LIVE IN A WORLD where we can ditch proprietary software and still have the same level of functionality with free software, but that world is possible. This year marks the 30th anniversary of the Free Software Foundation, the organization that oversees the GNU project and pushes for software freedom.

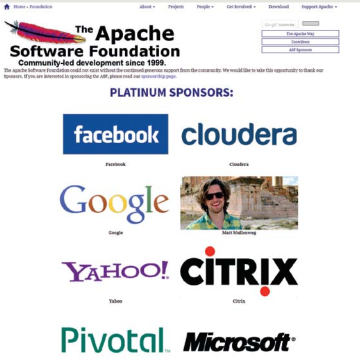
GNU brought us most of what we now consider the core tools (like the GNU C Compiler) in GNU/Linux. For that, every GNU/Linux user should be grateful. As Richard Stallman would say, Linux is just a kernel; GNU is the OS. And lucky us, the programs and utilities that comprise GNU are free.

Last month, I wrote about how proprietary software is needed in GNU/Linux, for the time being. It offers a usable experience to those who need features unavailable through free or open-source channels. That's not all bad, either. The vast majority of games are proprietary and are likely to stay that way. Games, like films, don't easily lend themselves to an open-source or free software model. Games are artistic storytelling media, not utilitarian tools.

I also talked about how bringing proprietary software (besides games) to GNU/Linux could draw more users to the OS. I can still hear Richard Stallman's howls of rage (I hope my uses of "GNU/Linux" satiates the beast). But we won't need as many proprietary solutions if there are more free software solutions that meet users' needs. Free software too often falls short, or has the perception of falling short. But here's the thing: The onus falls on us, the community, to create a better experience.

Software costs money to develop. Hardware and server costs are hefty burdens. We can grow Linux as users by donating a few bucks.

"Lest someone think the free software community is made up of hippie commie pinkos looking for handouts, there is money to be made.



The Apache Software Foundation could not exist without the continued generous support from the community. We would like to take this opportunity to thank our Sponsors. If you are interested in sponsoring the ASF, please read our sponsorship page.

Apache is one of the lucky ones, when it comes to big corporate sponsors.

Corporate sponsors back many free software projects with money, or by hiring staff who contribute code. Those firms realize the value of free software in day-to-day operations. However, not all projects are so lucky.

Companies back projects that further their own bottom line, which results in a disparity between desktop applications and server applications. Just look at the number of corporate sponsors for the Apache Foundation. When you look at the patrons for the GNOME and KDE projects, corporate names are far fewer in number.

Lest someone think the free software community is made up of hippie commie pinkos looking for handouts, there is money to be made. There's nothing in the GNU General Public License that says you can't sell programs. It simply stipulates that the source code must be made available. Companies like Automattic (WordPress) and Red Hat (Fedora) have built successful businesses by selling or offering support plans for free software.

If you don't have dollars to spare, there are other ways to contribute. If you know how to write code, consider squashing a bug or two. There are also plenty of projects—like gnuTaxes—that need developers to pick up where the original creator left off.

If you're a writer, create some documentation or write a how-to. Graphic designers can contribute artwork. Even helping someone out on a forum, IRC channel, or social media goes a long way. Investment, in time or money, will make free software grow. Just as democracy is best realized when citizens participate, the open-source community requires the contributions of users. That's the spirit of free software: software for the people, by the people.

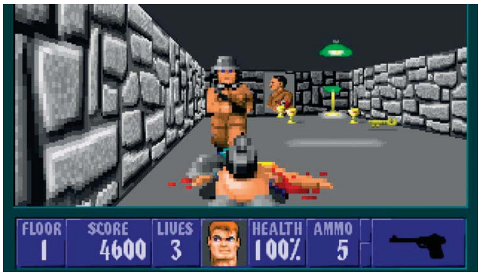
People will flock to freedom when they see it prosper, but will hesitate if it means a rough trail of usability and lack of features. Once we pave the roads, others will follow. Freedom is hard work, but we can do it.

Alex Campbell is a Linux geek who enjoys learning about computer security.

THE LIST

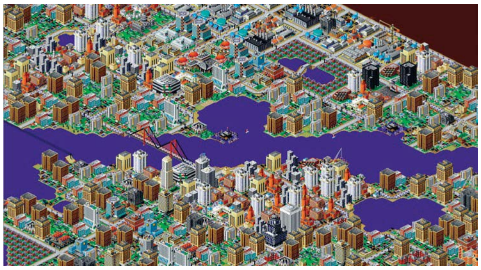
7 GAMES THAT CHANGED PC GAMING GRAPHICS

7


FLOOR
1
SCORE
4600
LIVES
3
HEALTH
100%
AMMO
5

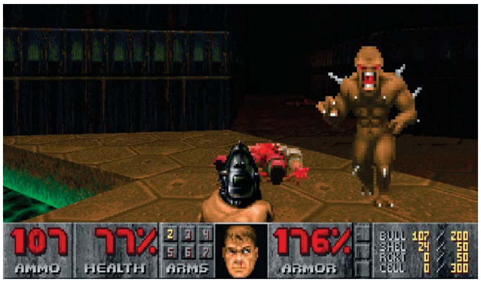
WOLFENSTEIN 3D Developed primarily by John Carmack, *Wolfenstein* introduced the FPS.

6



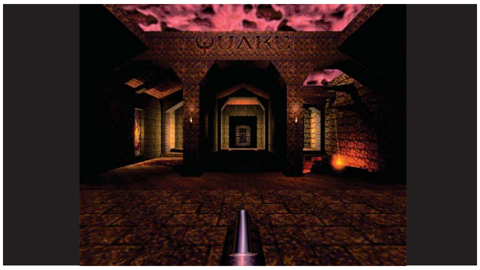
SIM CITY 2000 Maxis introduced the iconic isometric perspective, spawning a new genre.

5


107
AMMO
77%
HEALTH
2 3 4
5 6 7
ARMS
176%
ARMOR
BULL 107 / 200
SHEL 24 / 50
RCKT 0 / 50
CELL 0 / 300

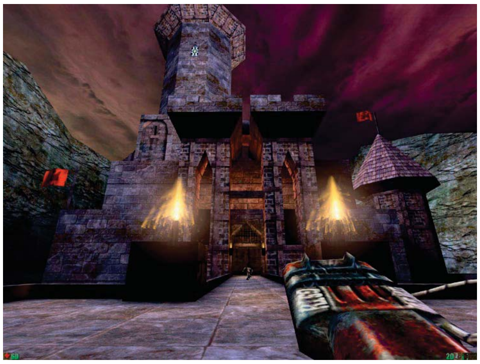
DOOM It took the visuals of *Wolfenstein 3D* to the next level with full texture mapping.

4



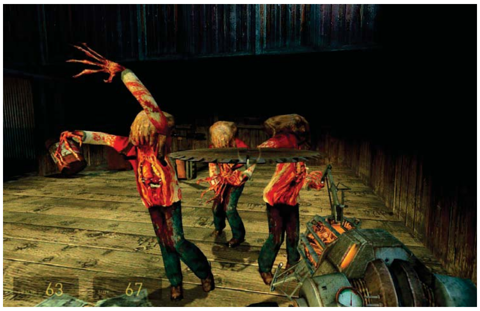
QUAKE Unlike *Doom*, *Quake* rendered polygonal models and had true 3D level design.

3



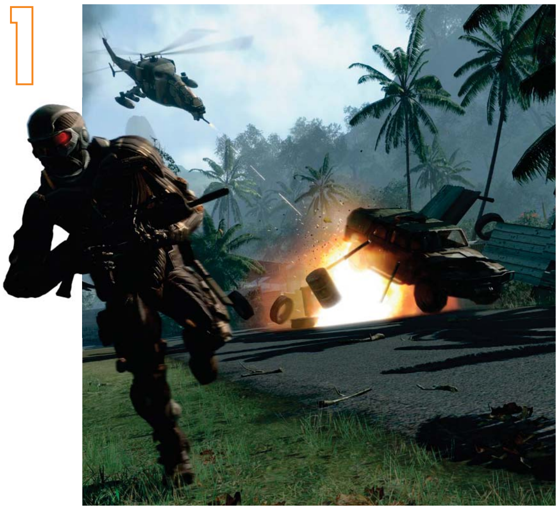
UNREAL The *Unreal* engine combined rendering, AI, and scripting in one package.

2



HALF-LIFE 2 Valve's beloved shooter combined crazy Havok physics with high-dynamic rendering. There was a crowbar too.

1



CRYSIS Due to how taxing it was, *Crysis* is the most iconic pixel-pushing game ever.

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TALKING

New APU to Boost E-Sport Streaming on Notebooks

Carrizo finally joins the ranks of AMD's Kaveri APUs, as a more power-efficient little brother

AMD launches its latest and greatest mobile APU, Carrizo, to bolster its laptop offerings. With more and more demands being placed on laptop processors to be power efficient and effective at competing in other areas, such as 4K streaming and gaming, we caught up with AMD's product manager Scott Stankard and business units CTO Joe Macri, to garner their insight into what this new APU brings to the marketplace.

AMD's Scott and Joe explain what Carrizo will bring to the notebook platform.

Maximum PC:
We're here at AMD's Carrizo APU launch. Beyond the fact that it's AMD's latest APU, can you tell us a little bit more about what makes Carrizo so special?

Scott Stankard:
This is our sixth-generation A-Series processor, and what we're really trying to do here is optimize around the key use cases that most people do with their mainstream PCs every day. So, you want to do smooth gaming? You've got that. If you want to stream premium content, we've made several optimizations around that.

Joe Macri:
This is the same 28nm processor, but we changed how we design. We put more into this. We have almost 30 percent more transistors in this design than we had in Kaveri, and we've done it by using high-density libraries and changing our design styles. Increasing transistors gives a massive value to the end user.

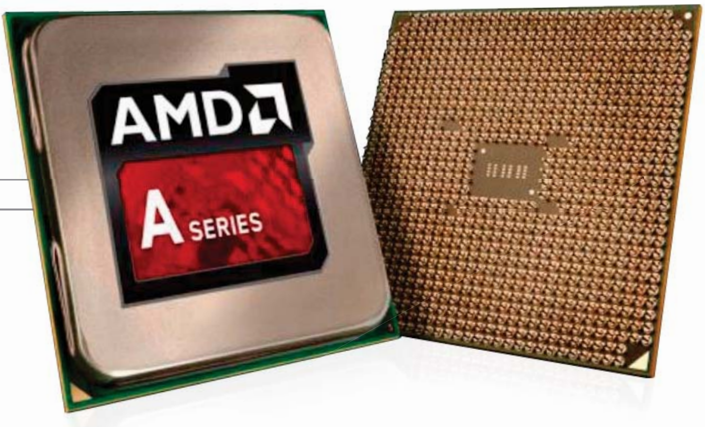
MPC:
AMD's really big on pushing HSA (Heterogeneous System Architecture). Can you explain what that is?

JM:
HSA allows us to take the CPUs and the GPUs and have them work on a compute problem, something that is not graphics that we would normally do on a graphics card. We are actually doing compute, the same thing we'd do on the CPU. HSA ties them all together with a single memory system so that they run most efficiently. You're always running the problem on the right component.

MPC:
Is HSA an open standard?

JM:
It's run by a consortium, which is the HSA Foundation. AMD is one of the founding members. We have companies like Samsung, Qualcomm, Imagination, ARM, they're all members, they all contribute. HSA started in an AMD lab, but then we realized very quickly that without this foundation, we wouldn't have this ecosystem, we wouldn't have the volume of partners, the volume of devices, to move people from the very traditional CPU-style compute, to this much more efficient, much better way of doing compute over all.

MPC:
Not all programs inherently support HSA. Is that something you're trying to push?



AMD's desktop equivalent, the A10-7870K.

JM:
Today, things are really done in OpenCL. That's how you exploit the HSA-capable hardware very easily. As we move forward, there'll be dedicated HSA programs that basically don't need a driver, with everything running under the user mode.

MPC:
What kind of performance gains have you been seeing from HSA?

SS:
If you have something that's OpenCL-accelerated versus not, you'll see something as much as 17 times faster performance with the OpenCL acceleration and HSA enabled.

MPC:
And 4K content. Can you delve into the current issue, and how your chip purports to solve it?

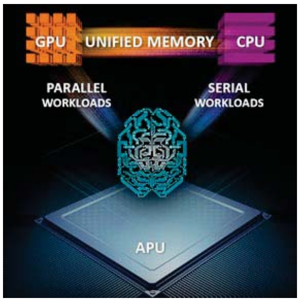
SS:
We're seeing a lot of 4K displays come out already. It's going to take a little time for complete adoption. What we want to do is be out ahead of that and be prepared, so, as that 4K content comes online, we have a notebook that someone can go buy and plug into that 4K display.

JM:
The H.265 decoder allows us to basically stream 4K much more efficiently, with much less bandwidth to move that 4K content. That's very important to the providers of that data, as well as the end user, because you may be sharing the link at your home or your business with many other users, so lightening that load is very important, and with the H.265 hardware decoder you get super smooth beautiful frames.

MPC:
And gaming performance? Can you talk at all about the improvements made to integrated graphics solutions?

JM:
If you buy a mainstream notebook, you deserve to be able to play games. Frankly, on the competition, you can't, unless you want to shell out the additional money required to give it a discrete graphics card. On our sixth-generation A-Series processors, we have discrete class graphics on the die itself, and so you can play many of those most popular titles that are available today, and have a great experience while doing so.

MPC:
In terms of Carrizo, what are the performance gains over Kaveri, or even Intel's Iris graphics?



HSA promises to improve performance by 17x in computing applications.

SS:
We'll see as much as 65 percent improvement over Kaveri, and we're actually lowering the TDP and total power consumption along with that. In some cases versus Intel, we might even double the performance versus what they offer today.

Some of the most popular games are those you're going to play online, so *League of Legends*, *DOTA 2*. With our sixth-gen A-Series processor, it makes that game very playable with great frame rates. But it's not only that, people want to be able to record this and stream it. When you're trying to stream and play at the same time, the competition starts to drop frames, down below 20fps sometimes, while we're sailing at 30, 40, 50fps while still streaming that same content.

MPC:
Mostly, the focus here is that Carrizo is more for notebook solutions, but Carrizo is also going to be on desktop as well?

> “The H.265 decoder allows us to basically stream 4K much more efficiently, with much less bandwidth to move that 4K content.

SS:
It's really a notebook and mobile product. In a desktop space, it will really look in at AIOs, small form factors, things that are generally more thermal and power-constrained along the lines of a notebook.

MPC:
Some people are concerned about how Intel has historically performed better on the CPU side. Any thoughts on that?

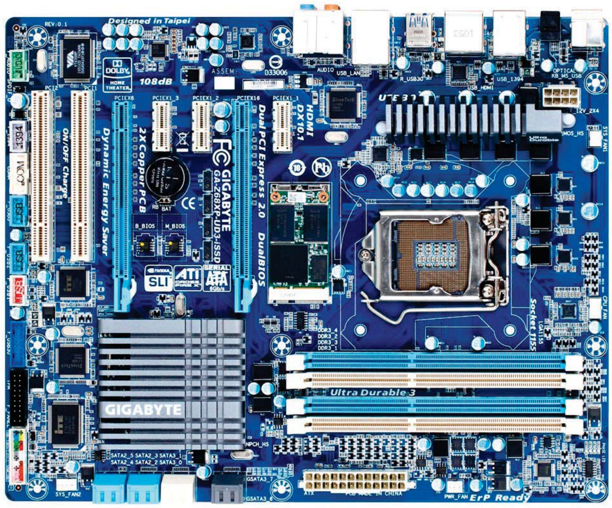
JM:
In real-world situations, we have a very nice balance between the GPU and the CPU. I wouldn't want to go and drag the CPU way, way up without dragging the graphics with it. I think that balance is key when we're delivering a notebook. You're not going out and upgrading the graphics or CPU in a notebook, you're buying a complete experience that needs to be balanced to give a good end-user experience.

SS:
When you look at how people actually use their notebooks, it's not things that are generally CPU-bound. Obviously, they're on the web, they're playing games, they're streaming multimedia. Those things are not generally CPU-bound. Even in those cases where Intel may have a slight advantage, our real point of view here is that, when users are actually using their notebooks, and on things they're actually doing, we've made improvements here where it matters. ⏻

DOCTOR

THIS MONTH THE DOCTOR TACKLES…

> GTA Performance
> $300 Graphics Cards
> Thunderbolt Pains



Originally designed for Sandy Bridge, Gigabyte later claimed support for PCIe 3.0 if you used an Ivy Bridge-based processor.

Dual Graphics?

Greetings Doc. My rig consists of an ASRock FM2A88X-ITX+, an AMD A10-7850K APU, two Crucial 240GB SSDs in RAID 1, and 8GB of Kingston HyperX DDR3 at 2400 MT/s. My question is which would be a better graphics solution? Install a Radeon R7 250 in the PCI slot and enable AMD's Dual Graphics tech, or forget the on-die graphics and install a Radeon R9 (or something comparable) in the PCI slot?

—Rick Stephenson

THE DOCTOR RESPONDS: If you're using a Mini-ITX mobo, Rick, the Doc can't help but wonder if your small form factor chassis can accommodate a dual-slot PCI Express card. Assuming it can, though, and that you have plenty of room (and airflow) in your case, the Doc would almost certainly bypass the on-die graphics and spring for something like a Radeon R9 270. You should be able to find one for around $150.

Why go that route when you already have a Radeon R7-class engine with 512 shader cores in your APU? As a rule, one graphics processor is better for compatibility than two or more. This is doubly true for AMD's Dual Graphics, which relies on up-to-date CrossFire profiles for increased performance. Even then, higher benchmark results aren't always indicative of a better experience with Dual Graphics. The Radeon R9 270, on the other hand, is still relatively affordable, gives you more processing power than the APU and R7 250 combined, and will almost assuredly support the newest games before a Dual Graphics configuration. Plus, it's well-balanced with the two Steamroller-based modules in your A10-7850K—paying more for an even faster card may not be worthwhile if it's bottlenecked by the APU.

GTA V Frame Rates

I started out by writing a long letter explaining the workarounds I've tried. But I'll distill it down to this: my frame rates in *GTA V* are horrible—15 to 20fps. I've done everything short of nuking my machine and reinstalling Windows. Given my system specs, I expect to see 30-40fps nominally. I'm not running at some insane resolution; I'm at 1920x1080.

Before pulling the trigger, there's one item I wanted to run by you to see if it could be the culprit. My motherboard (GA-Z68XP-UD3-iSSD) has "Dual PCI Express 2.0" printed on the board just above the PCIe slot. GPU-Z also shows "PCIe 16x 2.0." However, the Gigabyte website says the PCIe slot is 3.0-capable. Since third-gen PCIe is nearly double the throughput of 2.0, could this be a bottleneck causing the frame rate to suffer? If I have to get a new board, so be it. I just want to know what's going on.

—Michael Guimond

THE DOCTOR RESPONDS: Performance issues can be very frustrating to troubleshoot, Michael. But the Doc will focus on your PCIe question so you can move on to other possible causes before venting your frustrations on the denizens of Los Santos. Gigabyte's Z68XP-UD3-iSSD may support PCIe 3.0 transfer rates through its x16 slot, but because the controller it communicates with is built into your CPU, that component needs to support PCIe 3.0 as well. Unfortunately, Intel's Core i5-2500K is limited to PCIe 2.0, so you'd need something like a Core i5-3570K (or another Ivy Bridge-based CPU) for third-gen throughput. If you upgrade, be sure to flash the latest BIOS before removing your i5-2500K.

The good news is that PCIe bandwidth probably isn't your problem. Even a modern card like the GTX 970 doesn't move

↘ submit your questions to: doctor@maximumpc.com enough information over the PCI Express bus to saturate an 8GB/s link. You might want to try overclocking your i5 to see if that helps, though. *GTA* is notoriously processor-bound, so higher clock rates could improve performance. Also, make sure you have the latest patch. Rockstar recently published a handful of updates that made a big difference.

Shopping For Balance

Hey Doc, I received a Mini-ITX case (Cooler Master Elite 130) from a buddy and decided to build a system with it. I dropped in a Gigabyte GA-Z97N-WIFI motherboard with a quad-core Intel Core i5-4590 at 3.3 GHz. It's liquid-cooled by a Cooler Master Seidon 120V, and I maxed out the RAM using a G.Skill Ripjaws X Series 16GB kit. I have a Samsung 850 EVO 250GB SSD for the OS and a Western Digital Blue WD10EZEX 1TB for data that I repurposed from an old machine. The whole setup is powered by a Cooler Master G550M 550W PSU.

The issue I'm having is that the integrated graphics just isn't doing it for me. Can you suggest a graphics card that will work with my system and really kick butt? I've about $300 to spend and have been looking at the Radeon R9 290 and GeForce GTX 900-series. I should have enough available power to support either, but I'm not sure if one card offers an advantage over the other. I trust you and *Maximum PC* to give me an honest and unbiased recommendation. **—Steve**

THE DOCTOR RESPONDS: It's a privilege to have your trust, Steve. That's an otherwise highly capable PC you have, and your Cooler Master Elite 130 does in fact have room for any high-end graphics card you want to install (even though it's a Mini-ITX enclosure).

The Radeon R9 290 is a great card at around $250. Stepping up to a GeForce GTX 970 would be even better (it's faster, uses less power, and generates less heat). But that would put you over your budget. If 3D performance is your top priority, nothing beats AMD's R9 290 for less than $300.

Office Uproar

My company's IT group just forced me to "upgrade" to Office 2013. Every time they do these upgrades, everyone spends months figuring out how to undo the changes Microsoft made to its latest version. One I can't figure out is how to move the star icon for Favorites from the right-hand side of the screen back to the left, where I'm used to it being. Can you help? Also, is there a place we can send messages to Microsoft, telling them to stop making all these stupid changes?

THE DOCTOR RESPONDS: The Doc must assume this update also involved a new version of Internet Explorer, which now has its "View favorites, feeds, and history" tab in the upper right-hand corner between Home and Settings. There are a couple of ways to access this. First, you can turn on the Favorites toolbar by clicking "View → Toolbars → Favorites bar." This will put any link you've specifically added to the Favorites bar right under the Menu bar across the top. Or, if you'd like to enable the Explorer bar, which is the pane on the left-hand side of the screen with all of your favorites, click "View → Explorer bars → Favorites." Of course, if the Doc is misunderstanding the favorites to which you're referring, please feel free to send clarification. If you'd like to submit feedback, check out connect.microsoft.com. The company publishes a list of software currently accepting bugs and suggestions. IE is on the list, but Office is not.

ThunderboltEX II/DUAL

Asus's ThunderboltEX II/DUAL card first shipped with a nine-pin cable, but to work with the company's newest Z97 and X99 motherboards, you need a nine-to-five-pin adapter.

Thunderbolt Anger

I look forward to your column every month and finally have a problem that requires the Doctor's attention.

For some time, I've wondered why Windows is not embracing Thunderbolt tech. While some might covet its video capabilities, I've always been interested in Thunderbolt's data transfer speed. When Asus introduced its X99-based mobos, I thought it was time to give Thunderbolt a try. One of the features flaunted was that the X99 Deluxe worked with its ThunderboltEX II PCIe cards. I bought the X99 Deluxe, a ThunderboltEX II/DUAL, a Core i7-5930K CPU, and the rest of the hardware necessary for my new build. The build was uneventful, until it was time to install the Thunderbolt card. Although I'd read that the X99 Deluxe and the ThunderboltEX II/DUAL were compatible, it turns out the card has a nine-pin header, while the mobo has a five-pin Thunderbolt header. The cable that came with the card had nine pins on both ends and simply wouldn't work.

I quickly found out the Thunderbolt EX II cards were initially intended for the Z87-series motherboards, which had nine-pin Thunderbolt headers. Apparently, some later versions shipped with a nine-to-five-pin adapter cable that allowed them to be used with the Z97 and X99 mobos. I began an exchange with Asus to get the correct cable, leading to my most frustrating tech support experience ever!

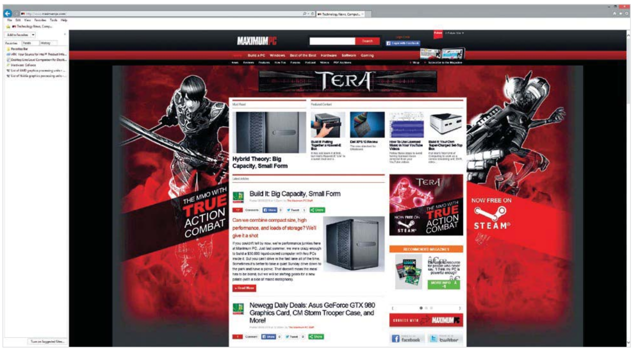
I was told they weren't compatible with each other; get a new motherboard. Then, it was call the Asus eStore (I did; they didn't know what I was talking about). I was told to order a newer version of the motherboard that came with the cable (no X99 boards do). How about looking on eBay? Or try a third-party Thunderbolt card with a five-pin cable.

At this point I've had it with Asus. But I'm stuck and would like to know if there's any other way to get the card to work with the X99 Deluxe, or if a third-party card is available that will work with the five-pin header. Thanks for all you do.

–Tony Paradowski

THE DOCTOR RESPONDS: This isn't the first complaint the Doc has fielded about Asus's Thunderbolt products, Tony. But you're right—that mobo and the ThunderboltEX II/DUAL should work together.

Company representatives say that customers with the older kit who contact the Asus service department are eligible to receive an adapter. Indeed, they claim many of these have already shipped out. The Doc knows some folks over at Asus who should be able to rectify the situation for you. Expect an email follow-up from one of them in the days to come. ⏻



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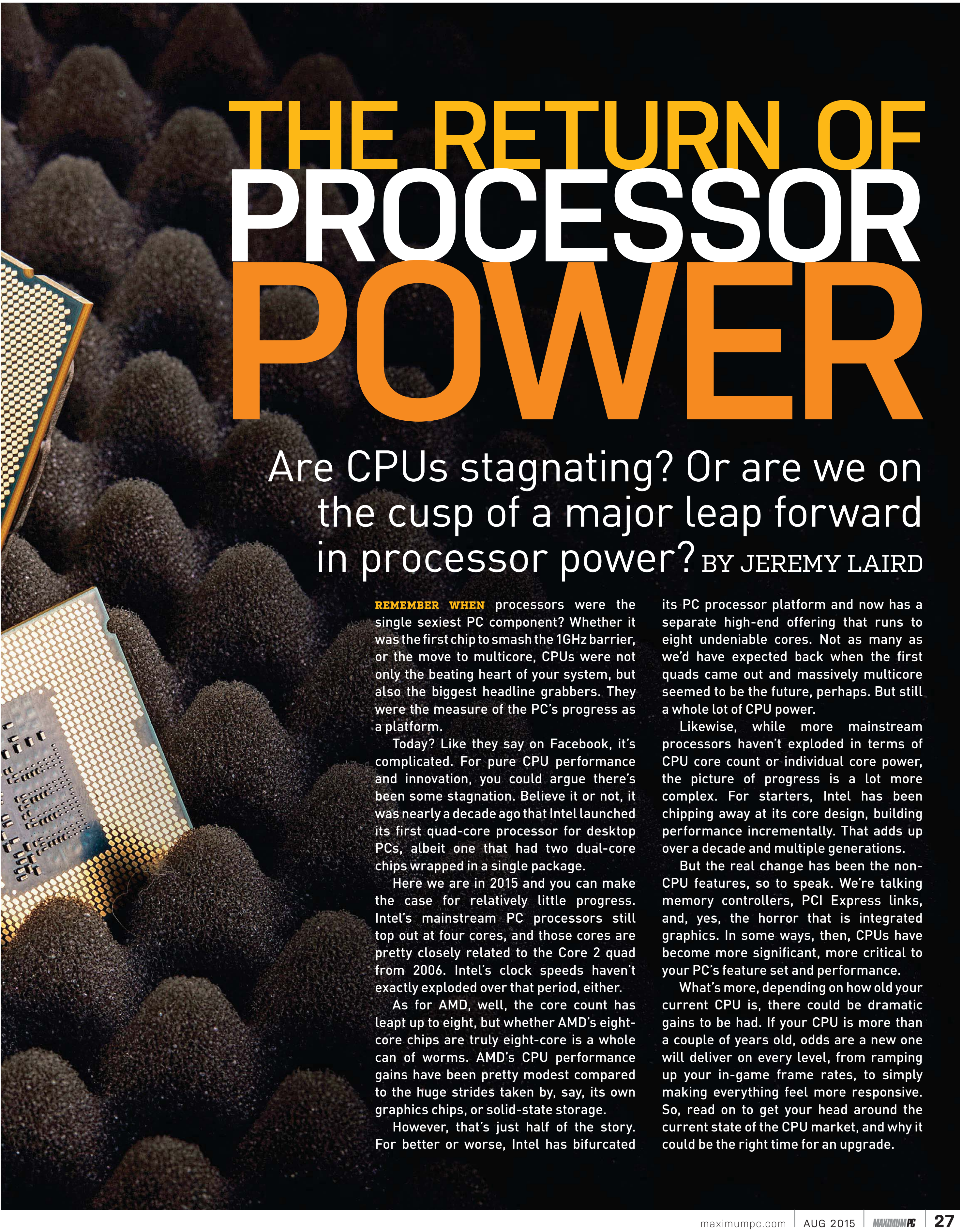


THE RETURN OF PROCESSOR POWER

Are CPUs stagnating? Or are we on the cusp of a major leap forward in processor power?

BY JEREMY LAIRD

REMEMBER WHEN processors were the single sexiest PC component? Whether it was the first chip to smash the 1GHz barrier, or the move to multicore, CPUs were not only the beating heart of your system, but also the biggest headline grabbers. They were the measure of the PC's progress as a platform.

Today? Like they say on Facebook, it's complicated. For pure CPU performance and innovation, you could argue there's been some stagnation. Believe it or not, it was nearly a decade ago that Intel launched its first quad-core processor for desktop PCs, albeit one that had two dual-core chips wrapped in a single package.

Here we are in 2015 and you can make the case for relatively little progress. Intel's mainstream PC processors still top out at four cores, and those cores are pretty closely related to the Core 2 quad from 2006. Intel's clock speeds haven't exactly exploded over that period, either.

As for AMD, well, the core count has leapt up to eight, but whether AMD's eight-core chips are truly eight-core is a whole can of worms. AMD's CPU performance gains have been pretty modest compared to the huge strides taken by, say, its own graphics chips, or solid-state storage.

However, that's just half of the story. For better or worse, Intel has bifurcated its PC processor platform and now has a separate high-end offering that runs to eight undeniable cores. Not as many as we'd have expected back when the first quads came out and massively multicore seemed to be the future, perhaps. But still a whole lot of CPU power.

Likewise, while more mainstream processors haven't exploded in terms of CPU core count or individual core power, the picture of progress is a lot more complex. For starters, Intel has been chipping away at its core design, building performance incrementally. That adds up over a decade and multiple generations.

But the real change has been the non-CPU features, so to speak. We're talking memory controllers, PCI Express links, and, yes, the horror that is integrated graphics. In some ways, then, CPUs have become more significant, more critical to your PC's feature set and performance.

What's more, depending on how old your current CPU is, there could be dramatic gains to be had. If your CPU is more than a couple of years old, odds are a new one will deliver on every level, from ramping up your in-game frame rates, to simply making everything feel more responsive. So, read on to get your head around the current state of the CPU market, and why it could be the right time for an upgrade.

Let's start with the elephant in the room, the Intel CPU architecture that dare not speak its name. Yup, it's Broadwell. And it's still not truly here, not in proper desktop format. Despite being due out last year.

What's going on? In truth, nobody outside Intel really knows. The company's move from 22nm, with Ivy Bridge and Haswell, to 14nm, with the upcoming Broadwell architecture, is at the center of everything. Intel protests that 14nm is all good. But it's perfectly obvious to everyone that bringing 14nm to market has been a major headache.

Not that we're criticizing Intel. As ever, it lives at the cutting edge of process technology. So, while it may have fallen behind its self-imposed, ambitious target of delivering a process shrink every two years, it's not like anybody else is doing better.

Intel's main rival is actually doing worse. AMD's highest-performing CPUs remain 32nm chips, albeit with manufacturing out of AMD's control since it spun off its chip-production arm. What's more, independent analysis of early mobile Broadwell parts by Chipworks has revealed Intel's 14nm tech is distinctly impressive, thanks to 13 layers and features like super-fine transistor "fins." Put simply, nobody is doing it better than Intel right now. However, distinct messiness in Intel's CPU roadmap remains.

By the time you read these words, Intel may have released a pair of Core i5 and i7-5000 series quad-core Broadwell chips for the LGA1150 socket and existing 9 Series chipset. Both sport a "C" suffix rather than the "K" indicator that Intel has been using in recent years, but are nevertheless "unlocked" chips supporting overclocking. But get this. Clock speeds are apparently lower than the top quad-core K Series Haswell models available today.

BROADWELL OR SKYLAKE?

Odd? Yup, but probably a result of the follow-up to Broadwell, known as Skylake and requiring yet another new socket, probably turning up within a few months.

But how should that influence your decision-making? The good news is that Broadwell's compatibility with the LGA1150 socket and the 9 Series chipsets, such as Z97 and H97, ensures some longevity. The bad news is that new socket for Skylake.

The thing is, if you already have an LGA1150 mobo, it's going to be fairly recent. It only appeared in mid-2013. What's more, it looks highly unlikely that Broadwell is going to be a major performance leap on the CPU side over Haswell. After all, Broadwell is technically a die shrink, not an all-new architecture. And it's not expected to do anything spectacular with regards to clock speeds. Quite the opposite.

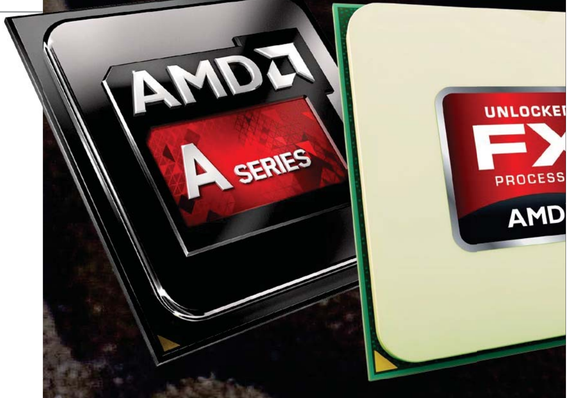
So, the case for upgrading from Haswell to Broadwell will be very marginal for most. The exception is if you went low-end with Haswell, but now have the cash for an upgrade. In that scenario, would it be worth waiting for Broadwell? Maybe. Not because we think Broadwell will be hugely compelling. But it's probably worth holding out a month or two just to be on the safe side. It's very possible that existing Haswells, like some of the models in our supertest this month, will remain the best bet.

Things get more complicated when you factor in Skylake. That's partly because Skylake's CPU performance is even more of an unknown quantity. It's also because Intel has revealed some interesting info regarding the Skylake platform. It will require the new LGA1151, which is a pain, but we're convinced there are good technical reasons. For starters, Skylake will support DDR4 system memory, which means more memory bandwidth. That's unlikely to dramatically boost performance, but it's never bad to support the latest tech.

Of greater potential consequence is support for more PCIe lanes and the new 100 Series chipsets that will come with it. In the past, PCIe lane count hasn't been hugely critical outside of systems running multiple graphics cards. But PC storage is in transition from the clunky SATA interface to quicker, solid-state optimized PCI Express interfaces including M.2. Haswell and Broadwell chips on the LGA1150 socket have only 16 lanes. On paper, a performance graphics card wants all 16. You can't just pinch a single lane from the graphics—take even one for your SSD and the card will drop all the way to eight lanes.

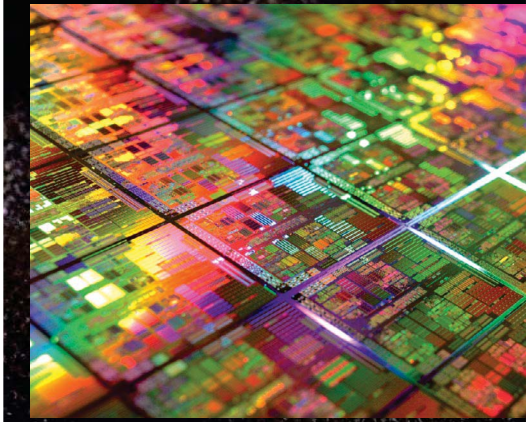
Anyway, it's possible that handing over lanes to an SSD could impact graphics performance. But Skylake and the 100 Series chipset deliver 20 lanes, giving you four spare lanes for fast storage. Hurrah. In truth, it's not actually clear how critical all of this will be. We don't think it will truly be a factor for several years, but it's clear enough that if you want to be absolutely sure of avoiding performance compromises, you need to wait for Skylake.

Unless, of course, you're willing to invest in Intel's existing high-end platform and the LGA2011v3 socket. Even the entry-level Haswell-E processor for LGA2011, the Core i7-5820K, packs a healthy 28 lanes. As for the AMD options, well, there's no denying AMD desktop platforms are falling behind in both features and performance. But they can still make sense as value propositions. To find out a little more, catch our guide to AMD's upcoming CPUs, opposite, and then flick on to our reviews of six of the best available CPUs from both Intel and AMD, for a great overview of your current options.



AMD APUs aren't exactly killer, but can make for a good budget box.

AMD's FX chips are still made on ancient 32nm production tech.



What's going on with Intel's desktop Broadwell CPUs? We wish we knew.

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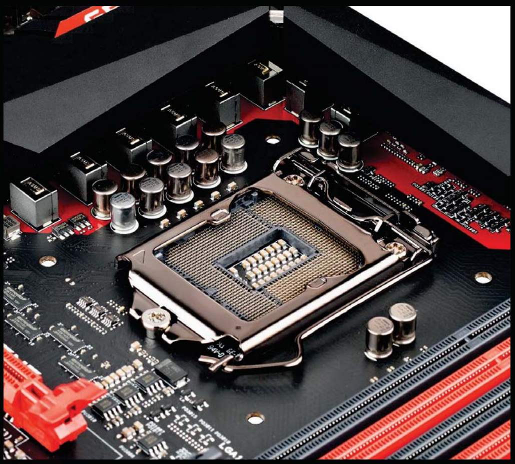
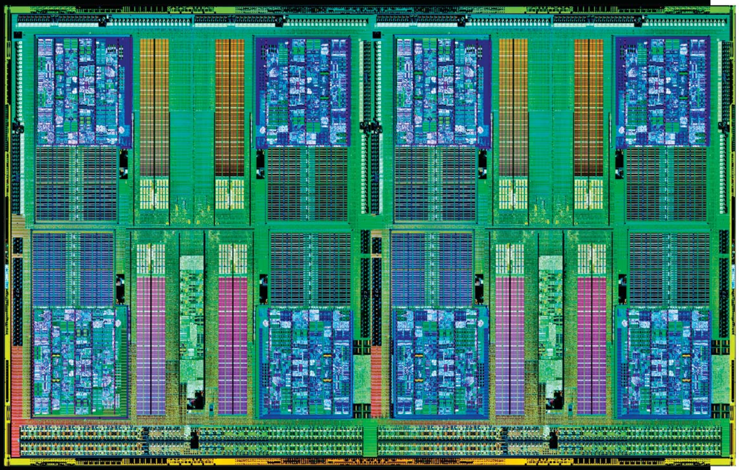
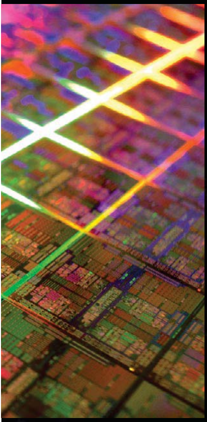
> **"CPUs have become more critical to your PC's performance.**

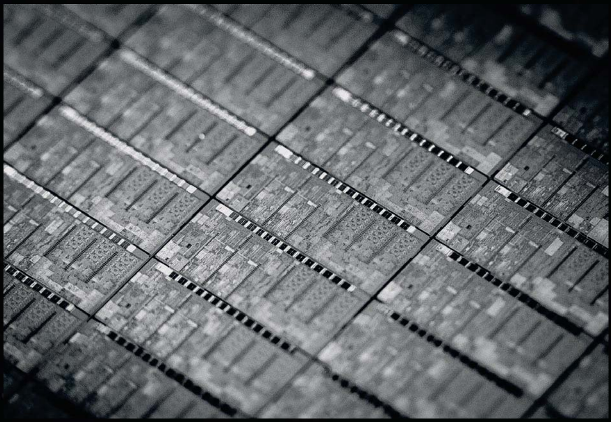


Intel's LGA1150 socket lives on, but only just.



Bye-bye Bulldozer? AMD's all-new Zen CPU is due next year.





14nm silicon has been problematic for Intel.

PCI Express-based SSDs could clash with performance graphics cards.

Intel's X99 platform and the 5820K chip are where it's at for serious performance.

If you want lots of PCIe lanes today, you'll have to pay up for Intel's pricey LGA2011v3 platform.

AMD's Bold New Plan

ZEN ARCHITECTURE IS SET TO CHALLENGE INTEL DOMINANCE

Keeping track of AMD's plans is never easy. But here's the good news. The latest update provided by AMD for investors makes for seriously sexy reading for PC enthusiasts. It's exactly what we wanted to see.

In short, it's all about a brand-new CPU architecture called Zen. It looks like everything else either dies or is on hold until Zen is out of the door in 2016. That's good because Zen is a new high-performance x86 core that AMD says addresses all the shortcomings of its existing Bulldozer-based CPU designs.

Out goes the Bulldozer's modular makeup with shared floating point units for each pair of integer execution resources. In comes something that looks a lot like an Intel CPU. That means traditional cores with not only much better capacity for IPC, or instructions processed per clock, but also simultaneous multithreading that's a dead ringer for Intel's Hyper-Threading.

Oh, and the whole thing will be built on 14nm process tech and it's due next year. And get this. AMD is claiming IPC improvements in the order of 40 percent. If AMD delivers all that, we're going to be giddy, because it'll mean Intel will finally have some serious competition. That will be excellent for everything from driving down prices to pushing up performance all-around.

Overall, AMD's latest update was a shift back toward the stuff we care about the most, namely traditional high-performance x86 processors. The company hasn't entirely ditched plans for its K12 ARM CPUs. But they've been deprioritized until Zen is on the market and won't now appear until 2017.

A huge question over the execution of these plans remains, of course. The launch of the existing Bulldozer series of CPUs wasn't the company's highest point to date, as it arrived late and failed to live up to expectations. We're therefore hopeful, but not making assumptions. Bring on 2016 and bring on Zen.

AMD
AD785KXBI44JA
JA
U33HS00
ES
A004142

AMD A10-7850K

The future is fusion. But not yet...

Budget performance, without a budget price tag to match.

FUSION CHIPS ARE COMING. So everyone keeps telling us. And you know what? They are undeniably right. The thing is, what happens in the future doesn't help up in the here and now. It isn't much use if what's predicted for the future arrives too late to be relevant before the PC processor you buy today spirals off into obsolescence.

That's the fundamental problem for chips such as AMD's A10-7850K. In many ways, its CPU-GPU fusion of traditional processor with graphics functionality is a glimpse of how all PCs will be one day. It's how both of the latest games consoles from Sony and Microsoft already are, and, it can hardly be denied, how most of Intel's mainstream CPUs are now built. Every Intel CPU for the LGA1150 socket has integrated graphics, whether you like it or not.

But that doesn't mean it's actually good news from the end-user perspective, especially if you remotely care about gaming. The problem is that integrated graphics, even the very best currently available, still isn't great for gaming. And the 7850K has integrated graphics about as good as it currently gets.

The specs are pretty impressive. The 7850K's graphics subsystem has 512 so-called compute cores. They're not just any old compute cores either, they're GCN-spec cores, and thus essentially the same as AMD's top graphics cards and indeed the latest games consoles. In fact, the Microsoft Xbox One has 768 GCN cores in its graphics subsystem, which makes for an intriguing comparison.

Problem is, the Xbox also has a high-speed memory system to feed those cores, while the 7850K shares a standard dual-channel DDR3 memory controller between its four CPU cores and those 512 GCN cores. The upshot is that buying the 7850K as a single-chip gaming solution isn't a goer. It lacks sufficient graphics performance for serious gaming on its own.

Where things arguably get more interesting is if you pair it with a cheap graphics card in dual-GPU mode, combining the power of the integrated graphics with that low-end add-in board. On paper, it's quite a proposition. In practice, you're still talking about modest gaming performance, but now you've added the vagaries and reliability concerns of a dual-GPU rendering solution. In short, it's not for us.

GOING SOLO

All of which means the 7850K has to make a decent case for itself simply as a CPU. That's not exactly a given, especially when you consider that this "budget" chip actually costs over $130. As a straight CPU, it even loses out to the dual-core Pentium chip in some tests. Basically, anything that majors on single-threaded performance looks a little ugly. But then, you can say that about any AMD CPU right now. Indeed, as a CPU to pair with a powerful graphics card, it doesn't make much sense. Hook it up with, say, a GeForce GTX 780, and it will still drag your minimum frame rate in *Total War: Rome II* down to 27 frames per second. Yuck.

Admittedly, it's better at multithreaded tasks like video encoding than the cheap Pentium chip. But it should be at roughly twice the price. What's more, because it's manufactured on a bulk 28nm production process rather than performance-orientated silicon, the overclocking headroom isn't all that great. Its 4.4GHz max overclock is the lowest frequency here.

So, as a CPU for a proper desktop PC, it's a struggle to recommend the 7850K. As the basis of a home-theater PC with a tiny bit of light gaming on the side, it just about stacks up. But that's quite a narrow niche you have to conjure up to allow the 7850K a realistic remit. Once AMD has sorted the memory bandwidth issue for its fusion-style processors, things will get interesting. Until then, they lack appeal as budget options for gamers and enthusiasts.

VERDICT
6

AMD A10-7850K

+ FUSION POWER Lots of technology in a single chip; AMD GCN integrated graphics; decent stock clock speed.

− NUCLEAR WASTE CPU performance is mediocre; integrated graphics isn't great for gaming; it's not quite cheap enough.

$134, www.amd.com

SPECIFICATIONS

CPU Cores/Threads	4/4
Process Technology	28nm
Clock Speed	3.7GHz, 4GHz Turbo
CPU Architecture	Kaveri
Socket	FM2+

AMD FX™
FD8350FRW8KHK
FA 1328PGN
9S84312G30296
AMD
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DIFFUSED IN GERMANY
MADE IN MALAYSIA

A good all-rounder, despite single-threaded struggles.

AMD FX-8350

Loads of cores. For not a lot of money

FOR ENTHUSIASTS, and especially gamers, it's tempting to think AMD's FX CPUs have become irrelevant. Knocking together an argument to that effect doesn't exactly demand mental gymnastics of Olympic quality, either. The argument would start with the fact that the Bulldozer architecture underpinning AMD's FX processors has basically been a failure. Even AMD is now tacitly conceding that, if you listen to what it's saying about its upcoming Zen processors, which are designed explicitly to address Bulldozer's shortcomings.

Even if Bulldozer had been a hit at launch, development since has been glacial. FX chips are still built on ancient 32nm silicon, while Intel CPUs are moving to 14nm. Making matters worse, AMD has let its desktop platforms and chipsets stagnate, too. Features like native support for USB 3.0 and PCIe storage? Forget it.

So, it's not hard to see why conventional wisdom says that if you're serious about your CPU, bag yourself something with an Intel badge. But conventional wisdom can get a bit smelly if you don't occasionally kick it out of bed. So, let's take the AMD FX-8350 with as open a mind as possible.

The FX-8350 is based on AMD's Vishera architecture. That means it's a 32nm chip with eight cores. Well, eight AMD-style cores, so four modules, each with a pair of integer execution units and a shared floating point unit. The idea is a slightly more hardware-intensive take on multithreading, compared to Intel's Hyper-Threading. Think of it as a halfway house between a four-core Intel chip with Hyper-Threading and a full-on eight-core chip.

Anyway, you get 8MB of level-two cache memory, plus another 8MB of level-three cache. The whole deal is clocked up at a healthy-sounding 4GHz baseclock with a small Turbo boost to 4.2GHz. Oh, and thanks to those slightly elderly 32nm transistors, it's a fairly power-hungry chip with an official 125W rating. Finally, it drops into AMD's long-standing AM3+ socket and pairs with DDR3 memory, which certainly gives a decent range of compatibility with current and quite a few legacy motherboards.

POWER PLAYER

As for performance, it really is a tale of two halves. Anything that's heavy on multithreading makes the 8350 look good. It's got the measure of the Intel Core i5-4690K, for instance, in both Cinebench R15 rendering and x264 HD video encoding.

However, shift the focus to more mixed workloads or, God forbid, something truly single-threaded, and the picture becomes patchy. In the Cinebench single-threaded rendering test, for instance, it's not even half as fast as Intel's i7-4790K.

But the picture in games isn't actually all that bad. A minimum frame rate of 36 in *Total War: Rome II* is just two behind the hallowed 4690K, for instance. That said, it's 10 frames per second behind the 4690K for average frame rate in *Rome*. You could also throw recording your game session in the background into the mix, which is something the thread-happy 8350 is much better at than the simply four-core Intel chip. Then again, your graphics card might be able to help speed that process up and make the comparison moot.

To underline that the 8350 is based on an architecture on its last legs, the backdrop is overall platform power consumption that far outstrips all the Intels, even the six-core i7-5820K beast and its complex server-derived platform, complete with quad-channel memory and more PCIe lanes than you can shake a broken SATA drive at.

So, the 8350 is probably better than you might have imagined as a gaming chip, and certainly looks good as an all-rounder, if video encoding performance is a big part of your computing mix. What it isn't, however, is a no-brainer as a CPU for a dedicated gaming box. And that's just fine.

VERDICT
8

AMD FX-8350

+ **JUST CORES** Great multithreaded performance; tolerable gaming grunt; competitive price tag.

− **HOPELESS CORES** Very power hungry; AMD's chipsets are ancient; hardly a purist gaming CPU.

$166, www.amd.com

SPECIFICATIONS

CPU Cores/Threads	8/8
Process Technology	32nm
Clock Speed	4GHz, 4.2GHz Turbo
CPU Architecture	Vishera
Socket	AM3+

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It's the king. At least until multithreaded gaming truly arrives.

INTEL CORE i5-4690K

Still the ultimate gaming CPU?

ALL THE GAMING CPU you'll ever need. That's the familiar refrain for Intel's quad-core Core i5 processors in unlocked K-series trim. The inference is that frills such as Intel's Hyper-Threading tech, which allows a single Intel processor core to crunch two software threads simultaneously in parallel, rather than sequentially in series, are irrelevant for PC gamers. The same applies to having a truck-load of cores. Six and eight-core chips sound impressive. But they won't run your games any faster. That's the sales pitch for the quad-core Intel Core i5-4690K. But is it actually true?

First, let's tick off the 4690K's basic speeds and feeds. It's a 22nm chip based on Intel's Haswell architecture, which means it's as advanced as it gets for desktop PC processors today. Those four aforementioned cores run at 3.5GHz, with a Turbo boost function up to 3.9GHz. As a "K" series CPU, the multiplier is also unlocked, allowing simple overclocking. And, as one of Intel's Devil's Canyon pairing, along with the Core i7-4790K, it gets improved thermal materials for better heat management compared to other desktop CPUs from the Haswell generation. As it happens, in our overclocking tests, the 4690K hits the same 4.7GHz as the 4790K. Nice.

More importantly, in our gaming benchmarks this month, the 4690K also runs the 4790K very close. The worst-case scenario is the minimum frame rate in *Total War: Rome II*, where the 4790K registers 43fps to the 4690K's 38fps. In *Battlefield 4*, there's literally nothing in it for minimum frame rates and even the averages are only separated by 3fps.

Actually, on that note, even Intel's six-core Core i7-5820K is essentially no faster in our game benchmarks. Even the mega-money Core i7-5960X Extreme and its eight mighty cores wouldn't be much faster in most games. That's the key to the 4690K's appeal. It's a giant killer at a relatively modest price.

Of course, if you broaden your computing remit, the 4690K is a less compelling proposition. Without Hyper-Threading support, it's at a clear disadvantage in applications like 3D image rendering and video encoding. The 4790K, for instance, is over 25 percent quicker when coding HD video in the x264 codec. Ouch.

FUTURE-PROOF?

Confidently, then, we can say the 4690K is a killer gaming CPU today. What's less certain is the outlook for the future. For the better part of a decade, the PC gaming industry has been promising that the future is multithreaded games. To date, that prediction hasn't entirely materialized.

Yes, games that scale to more than one CPU core are now the norm. But more than four CPU cores? That's still unusual. In that context, the 4690K is surely all the CPU you need for the vast majority of games today.

But here's the thing. There's actually good reason to think that could change dramatically in the next few years. Firstly, that's because the latest generation of games consoles from Microsoft and Sony have unambiguously thrown in their lot with multithreaded gaming. Both are based on essentially the same eight-core AMD CPU that offers fairly feeble single-threaded performance, and only makes sense if games are properly multithreaded.

Apart from the fact that a lot of PC games are straight ports from consoles, for better or worse, console games tend to set the broader game development scene. Just as important, the next version of Microsoft's multimedia API for the PC, DirectX 12, is going big on multithreading optimizations for games. It's due out with Windows 10 later this year.

All of which makes us a tiny bit unsure about recommending the 4690K for the long haul. For the next 18 months, it's an easy choice. How much longer after that it will continue to look good is a tougher call.

VERDICT
9

Intel Core i5-4690K

➕ **PC GAMER** Awesome gaming performance; tolerably affordable; runs relatively cool and quiet.

➖ **PC LAMER** Games might be going multithreaded; not the best all-rounder; Intel's Broadwell is coming soon.

$225, www.intel.com

SPECIFICATIONS

CPU Cores/Threads	4/4
Process Technology	22nm
Clock Speed	3.5GHz, 3.9GHz Turbo
CPU Architecture	Haswell
Socket	LGA1150

PC GAMER
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A meaty chip, but we'd stick with the 4690K or pay up for the 5820K.

INTEL CORE i7-4790K

Intel's devilish quad-core all-rounder

NORMALLY, buying the most expensive version of any CPU is for chumps. It means having your wallet hammered in return for a spec bump that's more about scoring a PR win, than actually improving your end-user experience. Should you therefore be doubly wary of the Intel Core i7-4790K? After all, it's just the top chip for Intel's LGA1150 socket. It's a stopgap replacement for what was once the range-topping quad-core Intel Haswell CPU, the 4770K.

In fact, perhaps the only reason the 4790K even exists is because the 14nm Broadwell CPU architecture is running late in desktop format, and Intel wheeled it out for the sake of simply having something new to sell. Is it the ultimate PR processor?

That's not entirely fair. The 4790K isn't simply the same old Haswell quad-core chip taken from a better speed bin and running at slightly higher clocks. There's more to the 4790K, and its so-called Devil's Canyon sibling, the 4690K, than that.

The big news is an upgraded thermal interface material, or TIM. The TIM is a thermal material, which connects the CPU silicon with the metal heat spreader that forms the top of the CPU package, and interfaces with whatever cooler you're using. Arguably, the 4790K only benefits from an improved TIM because Intel had cheaped-out on the TIM for mainstream Haswell processor models. Plus, some argue it's increased spacing between the silicon and heat spreader, not the TIM, that's been the problem with Intel CPUs of late.

Either way, for the two Devil's Canyon chips, Intel upgraded the TIM and in turn bumped up the clock speeds pretty dramatically. Where the older 4770K was clocked nominally at 3.5GHz and 3.9GHz Turbo, the 4790K rocks in at 4GHz and 4.4GHz, respectively. By any metric, 500MHz is a healthy boost.

The consequence is a quad-core, eight-thread CPU that looks pretty fast in almost any test. At stock clock speeds, it's enough to make you wonder whether you really need that six-core 5820K CPU. After all, is the broader investment required for the upscale LGA2011v3 platform worth it to increase your video encoding grunt from 53 frames per second to 62?

What's more, at these clocks and with the Haswell architecture, single-threaded performance is simply monstrous. In fact, this Intel chip is about twice as fast in the Cinebench single-threaded test as the AMD processors in the lab this month. Not that they're directly competitive CPUs. But it does give you a flavor of the task AMD faces with its new Zen CPU architecture next year. AMD could take a big step forward and still be a fair way behind Intel.

PRICE PREMIUM

Still, if there's a disappointment with the 4790K, it involves overclocking. The difficult thing with overclocking, of course, is that it varies from chip to chip. You can't simply apply sweeping generalizations. For the record, our test chip tops out at 4.7GHz. But based on the 4790K chips we've seen ourselves, along with reports around the web, that seems fairly typical.

That's both a little disappointing in absolute terms, versus the standard factory clock speeds, and not dramatically better than the 4.6GHz we're used to seeing from the 4770K. So much for that upgraded TIM.

However, our main objection remains pricing, which, if anything, has crept up in retail reality recently. The top end of Intel's mainstream platform has always felt expensive. At over $320, the 4790K is no exception. As things stand right now, its appeal as a primarily gaming CPU, compared to the 4690K, is marginal at best.

If gaming is what you're all about, forget about the 4790K. If you've a broader remit, the 4790K makes more sense. But we'd suggest you spend a bit more and step up to the LGA2011v3 platform and the 5820K.

VERDICT 7

Intel Core i7-4790K

+ THE ONE RING Awesome at almost everything; even quicker when overclocked; improved thermal management.

− ONION RING A little short on PCI Express lanes; seriously pricey for an Intel LGA1150 CPU.

$325, www.intel.com

SPECIFICATIONS

CPU Cores/Threads	4/8
Process Technology	22nm
Clock Speed	4GHz, 4.4GHz Turbo
CPU Architecture	Haswell
Socket	LGA1150

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INTEL CORE i7-5820K

Hexa-core honey you can almost afford

An upgrade to the LGA2011v3 socket is now very tempting.

IS BIFURCATION NECESSARILY BAD? That sounds like a keynote speech at a dreary business conference. But it's actually been a critical question for performance PC lovers since Intel split its desktop processors into two distinct platforms way back in 2008.

Specifically, it means Intel has been running two mutually incompatible processor sockets, one for high-end desktop PCs, another for everything else. On the upside, creating a true high-end platform means Intel can inject features that just wouldn't be feasible in cost terms if present in every PC. On the other, it creates an impenetrable barrier in the upgrade path. No longer could you drop in every Intel CPU from poverty spec to bleeding edge into a single socket. Now you'd need at least a new CPU, new motherboard, and likely new system memory, too. Ouch.

What's more, for much of the time, the performance jump from the best of Intel's mainstream chips to the bottom rung of its high-end platform hasn't been spectacular, despite coming at a painful price. What's more, a closer look at Intel's high-end platform has always left the uneasy impression of being thinly disguised server hardware, complete with features that are fairly redundant for the desktop.

That's the conflicted context for the i7-5820K. It's compatible only with Intel's high-end platform, which today means the LGA2011v3 socket and the X99 chipset. With its quad-channel DDR4 memory subsystem, the sense of server-system bandwidth overkill remains. But the 5820K might just be the most appealing chip yet for one of Intel's modern high-end platforms.

Partly, that comes down to pricing. At almost $400, it's not cheap. But it's not *that* much more expensive than the top chip for the LGA1150 socket, namely the i7-4790K. OK, you have to factor things like mobo and memory into the equation. But odds are, whatever CPU you buy, you'll need a new mobo to go with it. You might be able to limit the overall price premium of going with Intel's high-end platform to around $100.

Interesting, but what does it buy you? In the case of the 5820K, the most obvious upside is an extra pair of CPU cores, so six cores in total. Plus, thanks to the delay in bringing the Broadwell family to market, both chips sport Haswell-style CPU cores, where previously Intel's high-end platform has tended to run a generation behind.

EXPRESS DELIVERY

Of course, the 4790K's cores are clocked higher at 4GHz nominal and 4.4GHz Turbo, versus 3.3GHz and 3.6GHz for the 5820K. But both chips are fully unlocked. In our overclocking tests, the 4790K tops out at 4.7GHz, with the 5820K only a little behind at 4.45GHz. That 250MHz difference represents roughly a 5 percent frequency disadvantage, hardly a huge penalty to pay for 50 percent more cores.

Even running at standard clocks, the 5820K inevitably hammers its quad-core sibling in heavily multithreaded software like image rendering and video encoding. Factor in overclocking and it's no contest.

You might expect good old games to turn the tables. Indeed, the 4690K is generally a bit quicker in games. But the advantage is hardly dramatic. Moreover, if it's a pure gaming CPU you seek, it's actually the 4690K and its simpler quad-core design and lack of Hyper-Threading support that makes for the uncomfortable comparison and the better bet, not the 4790K.

However, as an all-rounder, the 5820K is seriously appealing. That's especially true when you factor in its advantage in terms of extra PCI Express lane availability over any Intel CPU sitting in the LGA1150 socket. As SSDs move to PCIe interfaces, it could make the difference between running everything at full speed and having to make some tricky compromises.

VERDICT 8

Intel Core i7-5820K

+ **SPELLBINDING** Six of Intel's finest CPU cores; epic multithreading performance; best platform features in the business.

− **CURSE ON YOU** Overall platform cost is painful; ordinary single-threaded performance; needs to be overclocked to give its best.

$375, www.intel.com

SPECIFICATIONS

CPU Cores/Threads	6/12
Process Technology	22nm
Clock Speed	3.3GHz, 3.6GHz Turbo
CPU Architecture	Haswell-E
Socket	LGA2011v3

INTEL CONFIDENTIAL
QGCK ES 3.20GHZ
MALAY
L333C247

Fancy some 4.6GHz old-school overclocking action for $70?

INTEL PENTIUM K ANNIVERSARY G3258

A reminder of when clock speed was king

REMEMBER THE GOOD OL' DAYS when Intel, and AMD for that matter, really only made one CPU? Sure, you could still choose from a whole hill of processor models, from bargain basement to punitively overpriced, but underneath it all, it was just one chip from each outfit.

Back then, CPUs were all about clock speeds. Higher frequencies meant more performance and more money. OK, you might have found the odd feature was fused off. But clock speed was king. The fun bit involved buying a dirt-cheap model and clocking it to Hell and back. The result was often a high performance CPU for a pittance. But not these days.

There are two reasons for that. Firstly, variable core counts tend to spoil the fun. Intel, for instance, offers everything from dual-core right up to eight-core chips. In each case, that's all you get. There are no hidden cores to be re-enabled. The other problem is that the whole overclocking thing has been locked down tighter than a drug baron in a supermax prison. All the old-school fun involving bus speeds and dividers is ancient history. Your only realistic option is via the CPU multiplier. And that's only unlocked for a limited range of Intel processors.

It's all pretty miserable compared to the swashbuckling, frequency-free-for-all days of yore. At least it was until Intel unexpectedly remembered it had a whole army of keen PC enthusiasts ready and waiting to celebrate a bit of low-budget fun.

Enter the G3258, a one-off special designed to recall those heady early days when you could overclock almost anything.

In this case, we're dealing with a dual-core version of the same Haswell architecture found in every other Intel CPU here, including the super-flash six-core Core i7-5820K. So, it's bang up-to-date in architectural terms.

But, it's also conspicuously light on features. There's no Hyper-Threading. You don't get a Turbo mode. It just runs at 3.2GHz. You have to make do with 3MB of cache memory. However, as the "K" suggests, it is fully unlocked. So you can clock it as high as you dare, or at least as high as the silicon can cope with.

GIANT KILLER?

In the case of our test chip, that's a very creditable 4.6GHz. In other words, it'll run at roughly the same clock speed as the much more expensive Intel chips here. But, because it normally runs at a modest clock speed, 4.6GHz means an epic 1.4GHz overclock. And all for $70. Impressive, as they used to say in *Quake III*, back when giant-killing CPUs were the norm.

That said, the huge overclock is just as well, because the G3258's performance at its standard 3.2GHz clock speed is patchy. The budget gaming thing looks dicey when you see it delivering just under half the frame rate of a quad-core i5-4690K. Scary.

Moreover, even that huge 1.4GHz overclock only represents a 40-something percent overclock, while you'd need a full 100 percent to match the 4690K at stock clocks. So, yes. If you base a gaming rig on this special Anniversary chip, you're going to suffer lower frame rates, even if you clock it to the absolute max.

Of course, at this price point, there's only so much you can expect. The same goes for a CPU that supports just two software threads. We may not have entered the boldly multicore age of computing that was predicted a decade ago. But a desktop PC with just two cores and no per-core multithreading is still seriously old news. There's a limit to what you can expect.

However, clocked beyond 4GHz, the G3258 is great value and lots of fun. If you're on a budget or looking for a stopgap, then it makes sense. It's not a giant killer in the traditional sense, but that's because those days are almost certainly gone.

VERDICT
7

Intel Pentium K Anniversary G3258

+ PRINCE AMONG PROCESSORS
Dirt cheap; sports Intel's Haswell cores; overclocks like a trooper.

− PROCESSOR FORMERLY KNOWN AS...
Weedy performance at stock clocks; only two cores; short on features.

$70, www.intel.com

SPECIFICATIONS

CPU Cores/Threads	2/2
Process Technology	22nm
Clock Speed	3.2GHz
CPU Architecture	Haswell
Socket	LGA1150

BENCHMARKS

	AMD A10-7850K	AMD FX-8350	Intel Core i5-4690K	Intel Core i7-4790K	Intel Core i7-5820K	Intel Pentium K Anniversary G3258
Cinebench R15 (Single)	91	88	150	173	140	117
Cinebench R15 (Multithread)	311	570	586	880	1,006	235
X264 v4.0	24.2	43.9	40.1	53.3	61.5	16.9
Sandra bandwidth (GB/s)	14.3	15.8	17.7	17.7	41.5	17.8
TW: Rome II (min/avg fps)	27/46	36/54	38/64	43/67	38/66	34/53
Battlefield 4 (min/avg fps)	37/51	54/79	59/91	59/94	59/96	31/45
Peak Power (W)	131	218	122	195	175	83
Max OC (GHz)	4.4	4.6	4.7	4.7	4.4	4.6
Cinebench R15 Max OC	356	645	686	927	1,299	326
Power Max OC (W)	182	272	176	218	305	129

Overall winner is highlighted. The gaming benchmarks are run at their highest settings, with 4x AA running at 1080p. All chips tested with 8GB of RAM, except the Core i7-5820K, which was tested with 16GB, and Nvidia GeForce GTX 780 Ti.

SPECIFICATIONS

	AMD A10-7850K	AMD FX-8350	Intel Core i5-4690K	Intel Core i7-4790K	Intel Core i7-5820K	Intel Pentium K Anniversary G3258
Website	www.amd.com	www.amd.com	www.intel.com	www.intel.com	www.intel.com	www.intel.com
Price	$134	$166	$225	$325	$375	$70
CPU Cores/Threads	4/4	8/8	4/4	4/8	6/12	2/2
Process Technology	28nm	32nm	22nm	22nm	22nm	22nm
Clock Speed	3.7GHz, 4GHz Turbo	4GHz, 4.2GHz Turbo	3.5GHz, 3.9GHz Turbo	4GHz, 4.4GHz Turbo	3.3GHz, 3.6GHz Turbo	3.2GHz
CPU Architecture	Kaveri	Vishera	Haswell	Haswell	Haswell-E	Haswell
Socket	FM2+	AM3+	LGA1150	LGA1150	LGA2011v3	LGA1150
Score	6	8	9	7	8	7

And the winner is...

INTEL CORE i5-4690K

CONFIDENTLY, then, we can say the Core i5-4690K is a killer gaming CPU today. What's less certain is the outlook for the future. For the better part of a decade, the PC gaming industry has been promising multithreaded games. To date, that prediction hasn't entirely materialized.

If these six CPU models represent the current state of the PC processor market, what have we learned? For starters, it's a little disappointing to note that prices have crept up a little on a few of the Intel chips.

Inevitably, component pricing fluctuates. But the idea that you have to pay more for what are relatively elderly CPUs is tough to stomach. That said, it reflects the fact that we can no longer assume that computer chips are just going to always get faster and cheaper. Intel's difficulties bringing 14nm desktop chips to market, along with AMD's FX processors being stuck on 32nm technology, are testament to that.

INTEGRATED OR DISCREET?

The next problem involves integrated graphics. It's not something we discussed much in our reviews of Intel's CPUs. That's because Intel's patchy drivers and inadequate performance means integrated graphics remains irrelevant in the context of even remotely serious PC gaming. That applies to AMD's best integrated graphics, too, which uses up-to-date AMD GCN graphics tech. It's not truly gameable.

Discreet graphics is therefore the way to go, and, for the long term, that makes us just a little uneasy about every CPU here, save for the Intel Core i7-5820K. How so? Because of possible future conflicts between graphics and SSDs over PCIe bandwidth. It may turn out to be a non-issue. But it's a pity that we'll have to wait for Skylake later this year for a mainstream Intel processor with more than 16 PCI Express lanes piped into the CPU socket.

That said, perhaps the surprise package of this test is AMD's FX-8350. There's no denying the single-threaded shortcomings of its CPU core design. Nothing will change that until AMD's new Zen CPU arrives next year. In the meantime, the FX-8350 may be a little off Intel's pace in games, but in-game performance is certainly acceptable, especially if you overclock. Factor in strong multithreaded performance and the FX-8350 looks like a strong overall proposition. If only AMD's chipsets and platforms didn't look so old and crusty.

As for the AMD A10-7850K, we're less impressed. Like we said, the integrated graphics bit isn't really much use and the 7850K's dual-module, pseudo quad-core CPU is neither great for gaming, nor a multithreading beast.

Of our Intel quartet, the Pentium K Anniversary is a lot of fun, but only if you're committed to overclocking. At stock clocks, its gaming performance is poor. Next for the chop is the Core i7-4790K. In many ways, it's the best all-rounder here. But it's also expensive, and in terms of gaming at least, the benefits of its Hyper-Threading tech aren't all that compelling.

MONEY TALKS

Instead, if we wanted a chip with proper beefy multithreading performance, we'd actually prefer to pay even more and do the job justice with the six-core Core i7-5820K. It's a serious bit of hardware, especially when you factor in the advantages of the high-end X99 platform. As much as any CPU can be, it's an upgrade that looks a great long-term investment.

All of which means the i5-4690K remains the CPU of choice for gaming purists. It's not the absolute fastest gaming CPU you can buy, according to the benchmarks. However, we doubt any other CPU would deliver noticeably better gaming performance in the terms that really matter. And if you can't feel it, why pay for it?

> “It's a pity that we'll have to wait for Skylake for a mainstream Intel processor with more than 16 PCI Express lanes piped into the CPU socket.

Platform opportunity
Build the intelligent cloud
Reinvent productivity & business process
Create more personal computing
Platfo
Build the intelligent cloud

Get ready for Windows

Will Microsoft's new operating system be the return to form that everyone hopes?

By Maximum PC Staff

We all know that Windows 10 is coming. We even know exactly when, 29 July. For PCs and tablets, at least. The rough date was at first inadvertently leaked by AMD's CEO Lisa Su, in an earnings call, before being confirmed by an official Microsoft statement, on 1 June. And it's a perfect fit with Microsoft's previously stated intention to release "this summer." AMD will be glad for the release, and not just to save its CEO's blushes. Like many hardware manufacturers, AMD is hoping for an uplift in sales as people rush out to buy new machines and/or hardware to get the most from the latest major OS system.

Indeed, an indicator of a market that's waiting for a new Microsoft OS is that sales in PCs tend to dip leading up to the release. And that's exactly what's happening at the moment, with the likes of Nvidia lowering its forecast for the second quarter of the year from $1.18 billion down to just $1 billion (yes, we feel bad about using the word "just" there). Analyst Canalys predicts a 13 percent fall in desktop shipments in the lead up to the release of Windows 10. Even notebooks, which tend to weather such storms better than desktops, have been hit by a 4 percent drop in demand.

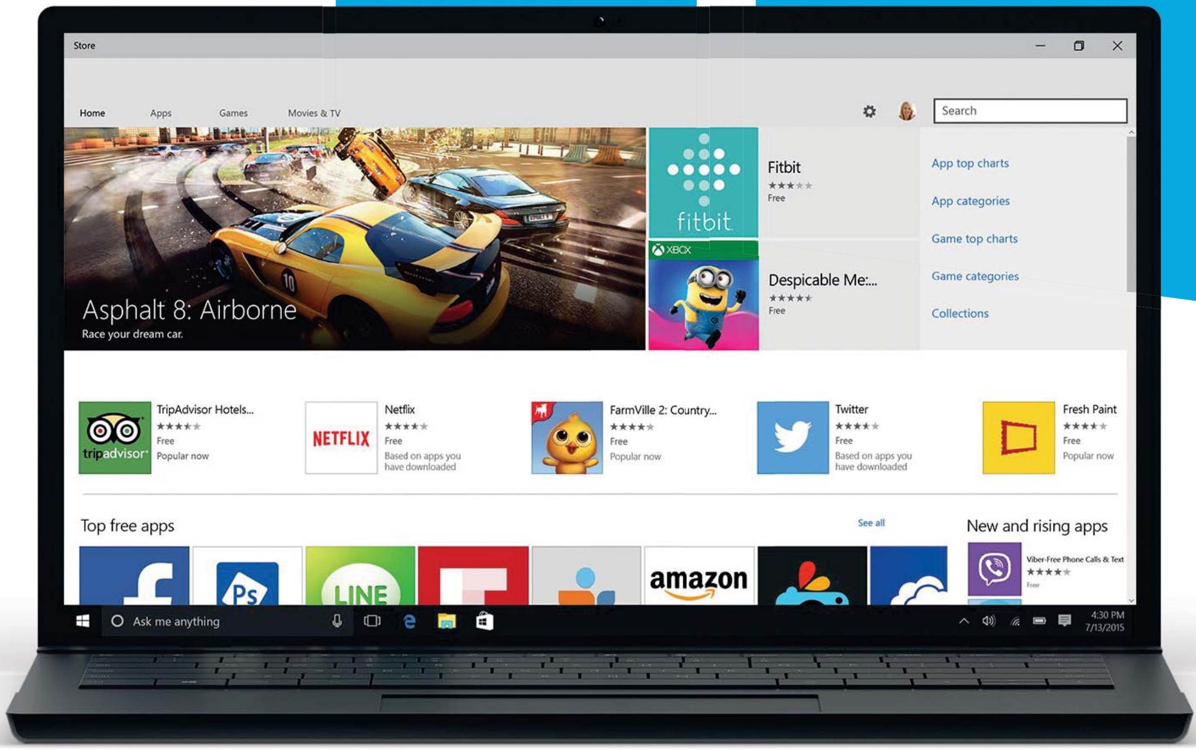
This could be one of the last times that the "softening of the market" happens though, as Microsoft has announced there isn't going to be a Windows 11. It's changing how it updates the OS. The big releases we've come to know and love, or hate, are about to be replaced with a much more dynamic model. A service model that should see updates delivered in a more regular manner, though how such updates are going to be financed is something that still needs to be explained.

Windows 10 has changed substantially since we first saw glimpses of the freely available Technical Previews at the start of the year, and we're not just talking about the OS itself. The unveiling of HoloLens, the ongoing work on Cortana, Continuum, Microsoft Edge (the successor to Internet Explorer), and information on what DirectX 12 is really going to do for you have changed the proposition considerably.

Turn the page to see why you should start getting excited about Windows 10.

rm opportunity
Reinvent productivity & business process
Create more personal computing

10


Store
Home
Apps
Games
Movies & TV
Search
Asphalt 8: Airborne
Race your dream car.
fitbit
Fitbit
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Despicable Me:...
Free
App top charts
App categories
Game top charts
Game categories
Collections
TripAdvisor Hotels...
Free
Popular now
Netflix
Free
Based on apps you have downloaded
FarmVille 2: Country...
Free
Popular now
Twitter
Free
Based on apps you have downloaded
Fresh Paint
Free
Popular now
Top free apps
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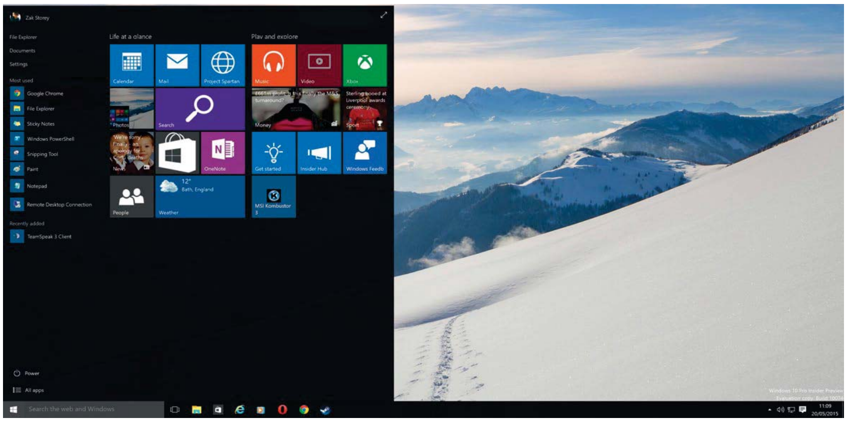
BACK TO THE START

Microsoft stakes a claim for a universal new era


Zak Storey
File Explorer
Documents
Settings
Most used
Google Chrome
File Explorer
Sticky Notes
Windows PowerShell
Snipping Tool
Paint
Notepad
Remote Desktop Connection
Recently added
TeamSpeak 3 Client
Power
All apps
Search the web and Windows
Life at a glance
Calendar
Mail
Project Spartan
Photos
Search
News
OneNote
People
12°
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Weather
Play and explore
Music
Video
Xbox
Money
Sport
Get started
Insider Hub
Windows Feedb
MSI Kombustor 3

Resize, reorder, drag and drop... the Start menu has returned!

As its 29 July release edges ever closer, the full details of Windows 10 are coming into focus. Much, however, remains unclear. We know, for example, that Win10 marks the end of Windows Media Center. It's gone, not to be replaced. That's big news. But all we know is that it's dead, nothing more. Our full preview of exactly where Windows 10 stands right now, and what it can do, starts on page 46. For the moment, here's a little more detail.

THE RELEASE DATE

Well, we know that you will be able to get Windows 10 for PCs and tablets, in 190 countries and 111 languages, on 29 July. Windows 7, 8, and 8.1 users will be able to upgrade, for free, at any point within the first year. You'll then receive free service updates for the lifetime of your device. That's even the case if you buy a Windows 8.1 device between now and the release date. What we still don't know, of course, is what happens beyond the lifetime of your device, or if you buy/build a new device after the OS is on the market (see "Regular Service," on page 48, for more on that).

Another area that remains unclear is when to expect other versions of Windows 10 to hit the market. What we do know is that there will be multiple versions of the operating system (see "The Seven Versions of Windows 10," on page 49), and that they will not be treated equally when it comes to release dates.

PCs and tablets will be the first to hit Windows double-digits, while phones, HoloLens, Xbox One, and more, will have to wait until later in the year. So, yes, Windows 10 does launch on 29 July, but not on every screen you own.

MOBILE WIN

Much of the latest technical information has come from Microsoft's Build developer conference, held in April, which was an opportunity for the company to show developers where it was at that moment.

On the first day, Microsoft's Terry Myerson surprised the crowd when he announced that Win10 will support apps written for iOS and Android. With some reworking, of course. This will undoubtedly blow the Windows 10 app store wide open.

ALL HAIL DIRECTX 12

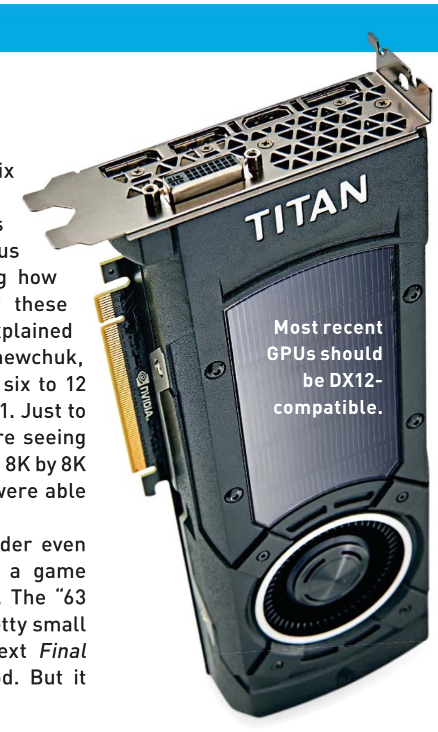
As far as we're concerned at *Maximum PC*, the most exciting aspect of Windows 10 is the accompanying release of DirectX 12. We've been thrilled about the potential of previous iterations of the gaming API, but this is the first time we'll actually see a significant focus on improving performance, as opposed to simply adding a list of features and effects that few developers ever use.

That's partly down to a big reduction in CPU overheads when running games, with Microsoft insisting DX12 will cut CPU loads by an epic 50 percent. More good news is that it should be compatible with most recent graphics cards and be pushed out across PCs, mobile devices, and the Xbox One. One graphics API to rule them all.

It's not clear yet which cards will be compatible, but Nvidia says all its existing DX11 GPUs will do the job. There's no word from AMD, but it's likely that all cards with AMD's GCN, at the least, will be compatible.

Final Fantasy developer Square Enix gave us a little taste of what DX12 is already capable of, at Microsoft's Build Conference, in April, and it got us excited. Simply put, it's jaw-dropping how realistic the visuals look. "Each of these scenes is over 63 million polygons," explained Microsoft technical fellow John Shewchuk, during the Build demo. "That's about six to 12 times more than we could do with DX11. Just to give you an idea on the textures you're seeing here," Shewchuk continued, "those are 8K by 8K textures. Significantly more than we were able to do [before]."

Of course, the demo doesn't consider even half of the graphical elements that a game released to the public would have to. The "63 million polygons" are confined to a pretty small surface area, so don't expect the next *Final Fantasy* game to look quite that good. But it should be mighty close.


TITAN
NVIDIA

Most recent GPUs should be DX12-compatible.

So, when Windows 10 for Phones launches later in the year, you'll be able to run Android apps, for example, on phones and small tablets (but not on a Surface, notebook, or desktop PC). They'll run on an Android subsystem that's likely to be based on KitKat (using the same hooks once used to put a POSIX subsystem in Windows NT).

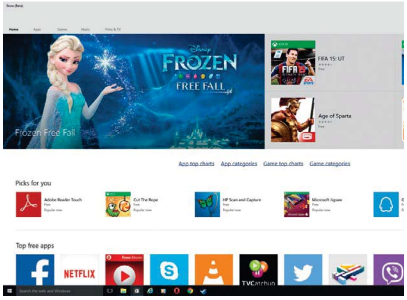
But this doesn't mean every Android app will run. "We replace the Android services with our own," explained Microsoft's Kevin Gallo. "We're running them in our own container—conceptually, as a universal app, so we use a middleware layer for translating APIs across, but they still run in the Windows app security model." That will improve performance and battery life over Android, he suggested. Standard platform capabilities will be redirected to the Windows equivalents—that's the file system, contact and photo integration, camera, sensors, and network connections.

Not all Android apps will work well this way. "Messaging apps and those that have deep integration into background tasks will probably have issues running," Gallo told us, "and it also comes down to [where they have good] performance." But then, he pointed out, "not every app works in every Android distribution."

Bringing Android apps to Windows Phones isn't the only way Microsoft is trying to bring developers and their apps to Win10. There's also the ability to wrap Win32 and Silverlight apps in the App-V container, or to bundle up a website as an app (complete with API calls to add Windows 10 features) and distribute them through the Windows Store. Plus, iOS devs can bring an Xcode project into Visual Studio and share source code between an iOS and Windows app.

BUILD ON

The Build reveals were free-flowing, though generally short on details. Windows 10 is now available on the Raspberry Pi 2 micro computer and Intel Minnowboard Max, for example. Some specific tailoring had to be done to fit the operating system on these tiny machines, resulting in a version of the OS earning the name Windows 10 IoT Core.



Microsoft has decided to deep freeze the old store design.

Contrary to fan fears, Microsoft is upping the *Minecraft* ante.

MINECRAFT MODDING TOOL

Microsoft picked up Mojang's *Minecraft* last year for a cool $2.5 billion. The loyal fanbase was apprehensive of what the acquisition would mean, but it looks like Microsoft understands the community better than many gave it credit for. At Build 2015, it announced that modding tools for *Minecraft* have been incorporated into its Visual Studio development environment via an add-in. This enables some of the basic functions of the game to be changed easily, and also supports templates that have been created by other modders.

Microsoft showed off what was possible with help from Aiden Brady, creator of the popular Mekanism mod for *Minecraft*. With a few lines of code, he was able to change the size of the TNT explosions using the Intellisense feature with Visual Studio. This isn't a replacement for the existing Eclipse tool that's at the heart of many mods, but instead designed to complement it to provide easy access to some of the games harder-to-access functions.

Microsoft's voice-based virtual assistant Cortana, meanwhile, will serve up information based on how people use the web and their PCs. The Cortana interface will suggest new apps based on what people search for, plus let users interact with apps through voice control.

STAYING SECURE

Microsoft has always taken security seriously, often releasing patches daily. Now, it's looking to take its security measures to the next level, with two-factor authentication (2FA) becoming standard on enterprise versions of the OS.

Microsoft also intends to protect user identities by storing user access tokens in a secure container that runs on top of Hyper-V technology, isolated from the rest of the OS. Windows 10 will also offer a data-loss prevention solution that will allow users to separate their corporate personae from their non-work ones.

So, that's some of what Windows 10 is promising for the future. On the next page we take a look at where it stands right now.

LTE
4:30
Connected to Living Room TV
tap to control
Welcome Miranda!
How can I help you today?
Cortana
5
Maps
Mail
10
Photos
Xbox
Interview new consultant
Fourth Coffee
4:00 PM
Monday 13

The mobile version of Windows 10 will support Android and iOS apps.

GETTING HANDS-ON

We test the latest early-access version of Windows 10

So, how does Windows 10 actually perform when used on a day-to-day basis? Well, we've been part of the Windows Insider program, which has given people early access through various phases of the development. This review is based on version 10.0.10074 (build 10074) of the OS, released on 29 April.

The great news is that even in the pre-release builds, Windows 10 is fast and stable. There are some problems we've experienced, of course, but these have either been ironed out, or—as with some speed issues concerning the new Start menu and Cortana—will surely be fixed for the final version. We hope. Anyway, here are the key features to get excited about.

THE NEW USER INTERFACE

People who skipped Windows 8 have nothing to fear—you'll feel right at home. In basic use, Windows 10 is not a million miles from Windows 7. You've still got the Start menu (though it's fundamentally changed) and key functions are all accessed from the Taskbar, which has a flat, functional feel. The design feels refined—windows borders are smaller, for example—but the innovations are subtle.

If you did immerse yourself in Win8, there's a little problem in that Charms have been removed. Microsoft said they were the future. They aren't. All the former Charms functions are contained in a new Notifications Center, launched from the Taskbar and designed to match the Notifications setup in Windows Phone.

Previously a work in progress, the Notifications Center is now both usable and powerful. A raft of individual settings (called Quick Actions) includes standard stuff, such as toggling Bluetooth, Wi-Fi, or Location on and off, but it's great to have. You can also get to Settings here, as an alternative to the Start menu, as well as switch into Tablet Mode. In the Settings app, you can select which Quick Actions appear in the Notifications Center, as well as which apps can send you Notifications.

START AGAIN

The Start menu is very Win8.1-like in that it features Live Tiles for at-a-glance information in apps. These were largely redundant for many Windows 8.1 users, mainly due to the lack of decent apps, but that seems likely to change. It remains to be seen, however, how useful this can be (we've used it a few times for looking at the weather and emails, but little else).

The remainder of the Start menu is much more like Windows 7, with controls for turning off your PC and restarting it, as well as most-used apps and the ability to scroll through all your apps in alphabetical order through an All Apps menu. File Explorer, Documents, and Settings are also present.

The Start menu can be enlarged for touch devices, via a control in the top-right, so it's more like the Windows 8.1 Start screen. It can also be resized to your taste. And, in case you were wondering, the Power User Menu is still there—just right-click the Windows logo. Once again, you can minimize everything by clicking in the far right-hand corner of the Taskbar.

File Explorer has been given a little bit of a makeover. You now have a Quick Access area to which you can pin and unpin any folders you want to access regularly. In the "home" screen of File Explorer, you can also see Frequent Folders and Recent Files. It's much more helpful now.

APPS

Microsoft is going big on so-called universal apps, the company's great hope being that developers will develop their apps once, to work across Windows 10 on PC, mobile, and Xbox, too—essentially, on every screen size. This is known as the Universal App Platform, or UAP.

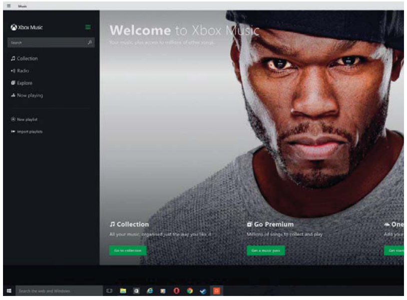
These are replacing what, in Windows 8 and 8.1, were known as Metro apps or Modern UI apps. They're different from desktop apps, but now co-exist with desktop apps on the desktop. They also have Live Tiles that live in the Start Menu.

> “People who skipped Windows 8 have nothing to fear—you'll feel right at home.”

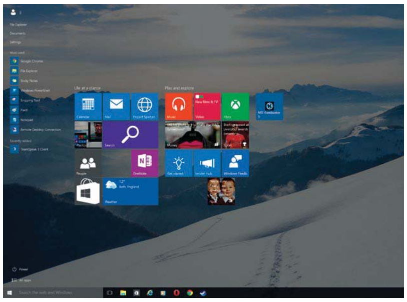
Microsoft doesn't want to repeat the mistake it made with Windows 8—assuming that developers will flock to the new OS—and so it's making it easy for developers to convert existing Android apps, while Microsoft Visual Studio 2015 now also supports Objective C (which is used to create iOS apps) and can compile it to universal apps.

WINDOWS APP STORE

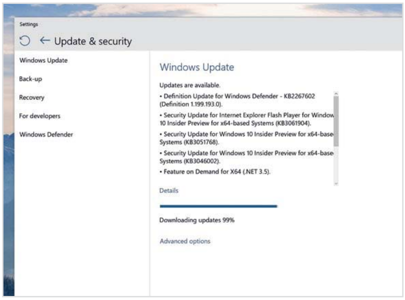
There's also a new Windows Store to come. This is still at the beta stage (in the Preview builds, Microsoft has included the original Store as the beta doesn't function completely yet). As well as a revamped design, the new store will house desktop apps as well as universal apps.



Microsoft's sleek new apps open directly to the desktop. No more tile pages.



Here's the expanded Start Menu for touchscreen and tablets.



Windows Update

Updates are available.

- Definition Update for Windows Defender - KB2267602 (Definition 1.199.193.0).
- Security Update for Internet Explorer Flash Player for Window 10 Insider Preview for x64-based Systems (KB3061904).
- Security Update for Windows 10 Insider Preview for x64-base Systems (KB3051768).
- Security Update for Windows 10 Insider Preview for x64-base Systems (KB3046002).
- Feature on Demand for X64 (.NET 3.5).

Downloading updates 99%

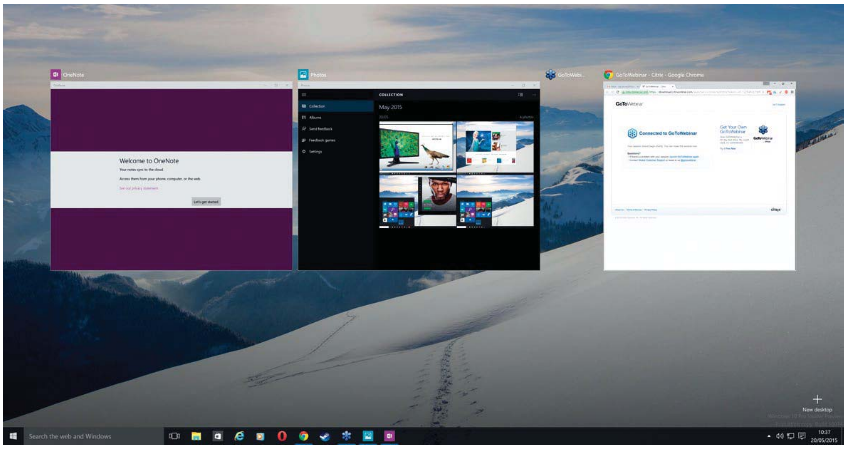
Windows Update, not causing problems for once.

Like universal apps, desktop apps installed from the Windows Store will be managed from there, so theoretically, they'll install quickly (without you doing anything more than clicking once to download/install), they can be uninstalled without hassle, and—crucially—they will be sandboxed from the rest of the system, à la universal apps. Devs will use an Application Virtualization (App-V) container to package their desktop apps for the Windows Store.

Organizations will also be able to deploy apps from their own versions of the Windows Store. This is all managed from the Business Store Portal, which will manage software licenses, centralized payment info, and more.

We mentioned before about universal apps coexisting on the desktop—that's meant Microsoft has had to find a new way to control them because the Windows 8 and 8.1 Charms are no more. This has meant a new menu bar in the top-left, as well as standard minimize, maximize, and close icons on the top-right. These apps can now be resized however you want.

Thankfully, the quality of the built-in apps so far is much better. There's a new Photos app that provides you with a complete back catalog, as well as editing and filter capabilities. Mail *actually* works now, and has some pretty useful features. Sport and News are also improved experiences, even if they still feel a little on the superfluous side. Best of all, these apps all start up nice and quick, too.



Task switching and quick view are finally included beautifully together in Windows.

TASK VIEW

There has always been Alt–Tab—well, since Windows 3.x, anyway—to switch between open apps. But over the last two decades, Microsoft has regularly dabbled with various other methods, from the Taskbar (Win95), to Windows Flip (Vista), and the swipe on Windows 8.

Now we have Alt–Tab *and* a new thing called Task View. This takes you to an app overview where you can use your mouse to select the app you want. It's pretty clever. In any mode of Win10, there's always an icon for it on the Taskbar.

But there's something else Task View can do: multiple desktops. An icon in the bottom-right enables you to add another desktop, so you can have one screen

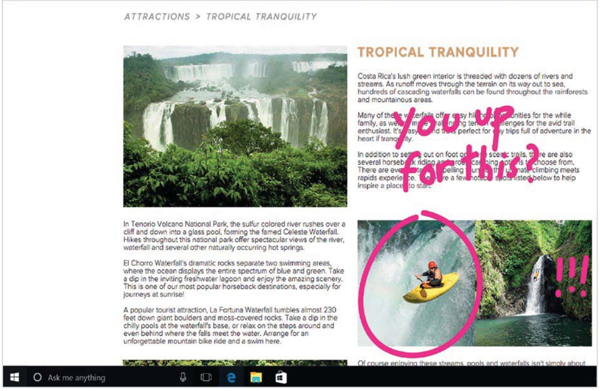
GOING OVER THE EDGE

Microsoft Edge (previously codenamed Project Spartan) is the new browser for Windows 10, and it's actually functional already, so it's time to get judging.

Getting started, there's currently no way to move your Favorites and bookmarks from another browser, but expect that to change. The final browser will also support extensions, which developers can easily port from Chrome. Plus, Edge has a fancy new "globe" logo, but that also feels distinctly unfinished.

Where Edge is impressing us, is in terms of raw performance. Pages render super quickly. Using Sunspider 1.0.2 to test JavaScript performance, Edge gave us a score of 201ms. This doesn't compare favorably with Internet Explorer 11, which scored 137ms. But it's better than Firefox 37 (260ms) and Chrome 43 Beta (303ms). Not too bad, considering it's far from the finished article. Browsing still needs work, mind you—some more-complex websites don't work properly. While we could check Gmail, Hangouts wouldn't load. When we tried connecting social accounts, it took three attempts to get it to work.

Many functions remain buggy. Typing in text fields can be laggy and some weird quirks exist, such as not being able to select the URL with a double-click in the address bar. Switching tabs was also a real pain, plus you can't rip tabs off at the moment. Some extra features are also absent, such as the ability to drag files into the browser (to attach them to an email or upload them to cloud storage).



ATTRACTIONS > TROPICAL TRANQUILITY

TROPICAL TRANQUILITY

Costa Rica's lush green interior is threaded with dozens of rivers and streams. As runoff moves through the terrain on its way out to sea, hundreds of cascading waterfalls can be found throughout the rainforests and mountainous areas.

Many of the[illegible] off[illegible] easy hi[illegible]unities for the while family, as we[illegible] ter[illegible]lenges for the avid trail enthusiast. It's [illegible] perfect for [illegible] trips full of adventure in the heart if tranq[illegible]ity.

In addition to se[illegible] out on foot o[illegible] scenic trails, there are also several horseb[illegible] riding [illegible] options to choose from. There are eve[illegible] climbing meets rapids experie[illegible] a few [illegible] listed below to help inspire a place to start.

In Tenorio Volcano National Park, the sulfur colored river rushes over a cliff and down into a glass pool, forming the famed Celeste Waterfall. Hikes throughout this national park offer spectacular views of the river, waterfall and several other naturally occurring hot springs.

El Chorro Waterfall's dramatic rocks separate two swimming areas, where the ocean displays the entire spectrum of blue and green. Take a dip in the inviting freshwater lagoon and enjoy the amazing scenery. This is one of our most popular horseback destinations, especially for journeys at sunrise!

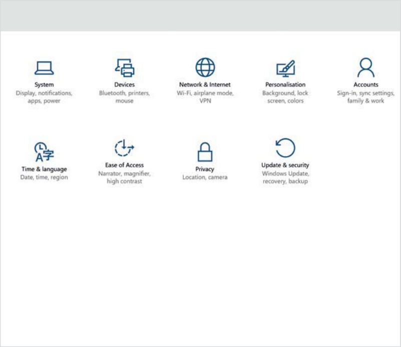
A popular tourist attraction, La Fortuna Waterfall tumbles almost 230 feet down giant boulders and moss-covered rocks. Take a dip in the chilly pools at the waterfall's base, or relax on the steps around and even behind where the falls meet the water. Arrange for an unforgettable mountain bike ride and a swim here.

Of course enjoying these streams, pools and waterfalls isn't simply about

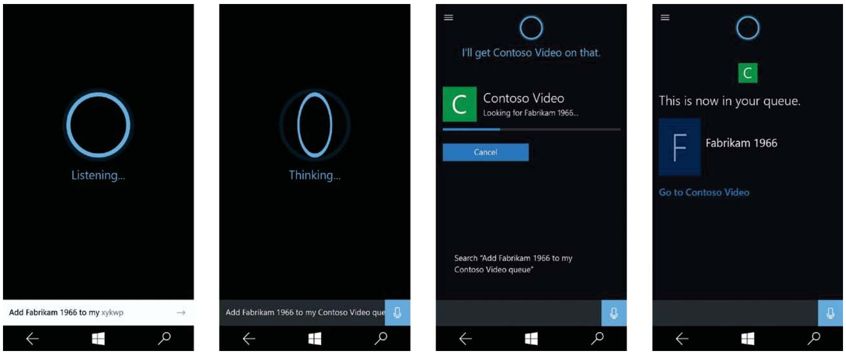
Let's talk about the features that do work. You can find stuff and highlight specific words using Ctrl–F. Copy and paste works without issue. There's a built-in note-taking mode, so you can save and annotate webpages, plus a reading mode that strips away the content you don't need.

There's a download pop-up panel that you can instigate from a downloads pop-up, or by using a button on the title bar. Similar to IE, this panel can display History and Favorites, while another view displays your Reading List. You're able to select anything and "Ask Cortana" about what you've highlighted by right-clicking. This brings up a sidebar where search results appear. The Cortana integration will enable you to search and add info to your Cortana profile more seamlessly, which should be useful.

If you asked us to sum up Edge in a few words, it'd be that browsing is OK, but there are very few bells and whistles.


System
Display, notifications, apps, power
Devices
Bluetooth, printers, mouse
Network & Internet
Wi-Fi, airplane mode, VPN
Personalisation
Background, lock screen, colors
Accounts
Sign-in, sync settings, family & work
Time & language
Date, time, region
Ease of Access
Narrator, magnifier, high contrast
Privacy
Location, camera
Update & security
Windows Update, recovery, backup

PC Settings revamped ready for launch.


Listening...

Add Fabrikam 1966 to my xykwp

Thinking...

Add Fabrikam 1966 to my Contoso Video que

I'll get Contoso Video on that.

Contoso Video

Looking for Fabrikam 1966...

Search "Add Fabrikam 1966 to my Contoso Video queue"

This is now in your queue.

Fabrikam 1966

The Cortana interface, where all your life decisions will soon be made for you.

for your email perhaps, and another for Photoshop. This is a nice new feature, but it's about time, considering it's been on Macs since 2009.

Apps can be open in more than one desktop, but you can't switch into windows that are on another desktop. Things are kept nicely separate. Alt–Tab only works within the desktop you're in. The only way to switch desktops is to go into Task View and select another open desktop. From here, you can also close desktops.

SETTINGS

If you used Settings in Win8 or 8.1, you'll know how half-baked it was. You basically opened it, realized you couldn't do what you wanted, and went to the Control Panel.

Well, the Control Panel is still there in Windows 10. And if you're a technical user, you'll come across it from time to time—for example, to disable a network adapter. But for most of us, you'll never see it. Settings is now a far more comprehensive solution, much more logically arranged. In early Windows 10 builds, it still seemed unfinished, but pretty much everything you'll need is now there, separated into nine distinct areas. You can also search in Cortana for a setting, and you can search within the Settings app, too.

SEARCH AND CORTANA

Rather than being at the bottom of the Start menu as in Windows 7, Search now has its very own home on your Taskbar. That's because Cortana, Microsoft's virtual assistant, is incorporated, and you can control it by voice.

Search, unfortunately, still needs a bit of work when it comes to finding things on your own PC. Microsoft is so keen to integrate potential web searches into the Cortana results that often you need to click again to find a file on your PC—a "search my stuff" option appears at the top of the menu.

This is especially the case when you're hunting for a generic file name, such as "holiday." As with previous versions of the operating system, you can tap the Windows key and immediately start typing to search.

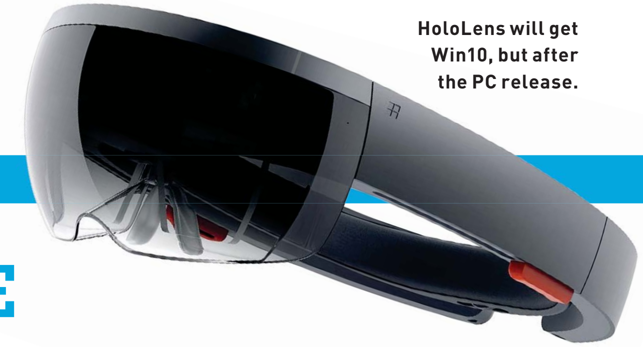
Cortana can display "at a glance" information that's of interest to you, while you're able to create and view reminders, see stocks, and much more, depending on how much input you give it.

Cortana is also being incorporated into Microsoft Edge, the new browser for Windows 10.

TABLET MODE

Microsoft is hoping a lot of tablets are sold in the coming years. Originally named Continuum, Windows 10's Tablet Mode is clever because it's automatic—detach the keyboard and the desktop prepares itself for touch, the Start menu becomes the Start screen, and apps appear full-screen. The Taskbar also changes to be more touch-friendly—the icons are more spaced-out, while the pinned app icons don't appear at all. You cycle through them in Task View.

If you want, you can toggle between Tablet Mode and non–Tablet Mode yourself, via the settings at the bottom of the Notification Center.



HoloLens will get Win10, but after the PC release.

REGULAR SERVICE

Microsoft revealed at the Ignite conference, at the beginning of May, that Windows 10 will be the last version of Windows. Before you reach for your digital "the end of the world is nigh" placards, this doesn't mean Windows is going to disappear. Instead, Microsoft is working toward delivering the OS as a service. This is something the company has talked about before, but it looks like it's finally set to pull the trigger.

Instead of releasing an entirely new version of its desktop OS every few years, Microsoft will take an Apple-like approach, delivering regular improvements through software updates.

This could explain some of the vagueness of the release dates. Maybe we won't have all the features we've been talking about on 29 July, but they will be added to the OS as time passes. Microsoft is making Windows 10 available as a free upgrade to all Windows 7, Windows 8, and Windows 8.1 users. It remains unclear, however, what sort of subscription pricing might be introduced down the line.

The Start menu and built-in apps are now unbundled from the main OS, so users can get faster updates. Rather than waiting for a full Windows update, Microsoft is delivering smaller standalone app updates, a feature we're seeing in the Windows Insider Preview with the Mail and Calendar apps. This has allowed smartphone manufacturers to update core apps—such as the camera, photo gallery, and mail—without waiting for mobile operators to push out an OS-wide update.

Microsoft's next major update, codenamed Redstone, is expected to arrive in 2016, extending Windows 10 support on devices such as HoloLens.

AEROSNAP

One reason why Windows 7 was such a great OS was that it brought us something else, AeroSnap. The ability to snap windows to the sides of your screen might seem small, but it's something many Windows users use every day. Windows 8 got it a bit wrong, as Modern UI apps could only be snapped in certain ways, but Windows 8.1 improved on this.

Windows 10 gives us something else: four-way AeroSnap. You can have four applications, one in each corner of your desktop. If you've got a laptop screen, this isn't too efficient, but if you've got a 27-inch panel, it might just be the ticket. In early builds, it worked as well as an umbrella in a hurricane, but now it's pretty good. You'll get used to it quickly.

HELLO AND COMMAND PROMPT

New systems that ship with Windows 10 and support biometric security hardware will enable you to use a fingerprint, face scan, or iris scan to log into Windows and apps, websites, and networks. This is called Windows Hello.

There's a new Command Prompt, too. Small beer, you might say, but you're now able to properly select text and copy and paste in and out. Ctrl–V really will work. Text also reflows as the window is resized.

EARLY VERDICT

Essentially, Windows 10 is still a work in progress. But as unfinished work goes, it's stunning. There are several reasons why we think it will be a success. There's the welcoming arms Microsoft is holding out to developers (if Microsoft can't make this work, it's a problem). Then there's the fact it will be a free download for consumers.

But above all, there's the fact that, as an operating system, *it just works*. If Windows 8 was the steepest learning curve imaginable, Windows 10 is like meeting a great friend you once knew, but they've bought some fancy new clothes, and you really do approve.

Release dates will vary between Win10 versions.

THE SEVEN VERSIONS OF WINDOWS 10

Microsoft has confirmed seven different versions of Windows 10 will hit smartphones, PCs, tablets, HoloLens, and enterprise devices later this year.

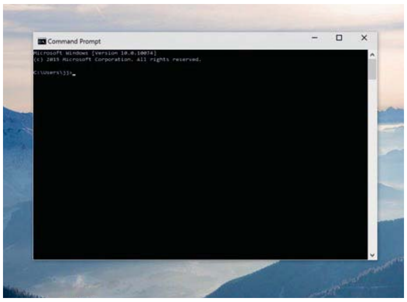
Windows 10 Home is the consumer desktop version for PCs, tablets, and 2-in-1s. Xbox One owners will also be able to play full games on any Win10 PC upon its release. Windows 10 Pro, meanwhile, offers a higher level of control over PCs, tablets, and 2-in-1s, and is geared toward small businesses. Alongside these sits Windows 10 Mobile for phones and smaller screen devices that will function in much the same way as its desktop sibling, thanks to the universal Windows apps used across Windows 10 Home and Mobile.

Enterprise customers will see a dedicated Windows 10 version that builds on Windows 10 Pro with a more advanced set of controls. Windows 10 Enterprise includes features, such as the ability to use Windows Update for Business, to manage the speed at which the new technology is adopted.

This is complemented by Windows 10 Mobile Enterprise, which brings a greater level of security and mobile device management, and is flexible when it comes to updating employee mobile devices.

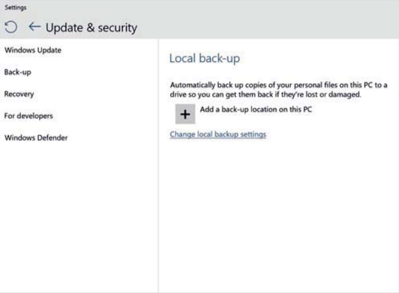
Lastly, Windows 10 Education is similar to Windows 10 Enterprise, except it's geared toward schools and promises paths for schools and students using Windows 10 Home or Pro devices to upgrade to this version.

Microsoft also confirmed there will be special versions for retail devices like ATMs, point-of-sale, handheld terminals, and industrial robotics. Windows 10 IoT Core will also be released at the same time.



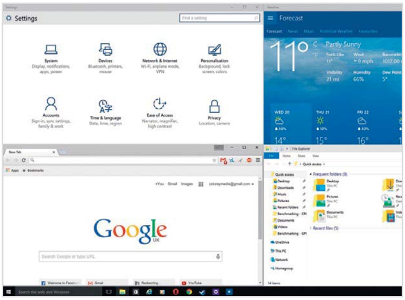
```
Microsoft Windows [Version 10.0.10074]
(c) 2015 Microsoft Corporation. All rights reserved.

C:\Users\jj>_
```

Copy and paste is finally in command prompt, after a mere 30 years.

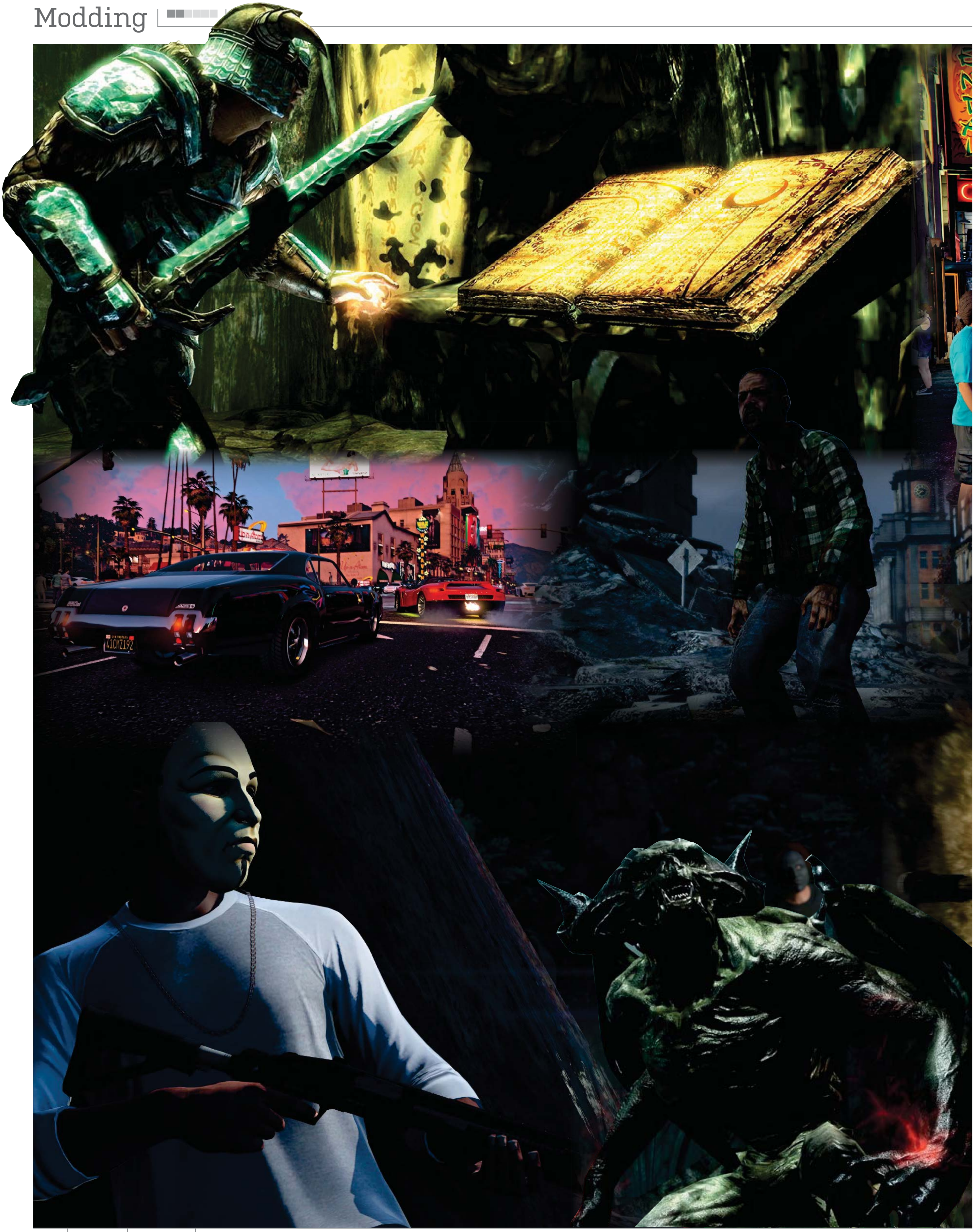


Automatically back up copies of your personal files on this PC to a drive so you can get them back if they're lost or damaged.

Windows Back-up makes its triumphant return to the operating system.



Snapping apps to corners in Windows 10 makes multi-tasking incredibly easy.



WE ARE THE MODS

Steam's paid-for game modifications were struck down as soon as they appeared. Why?

By Daniel Griliopoulos

By the time we'd started writing this article, the event that prompted it had… vanished. Valve had announced that modders could sell their creations on Steam, starting with several paid mods for the community's favorite project, *The Elder Scrolls V: Skyrim*. It seemed a natural move after its careful introduction of the Steam Workshop for free custom content and then Steam Marketplace for paid-for items in games like *Team Fortress 2*.

But, by the time we got around to writing about it, Valve had already rescinded that decision, closing the marketplace and refunding anyone who'd bought the mods. That's because a subset of both players and modders had gotten extremely angry. Now, the toxicity of the response wasn't surprising—the PC gaming community has a tendency to start a lynch mob at the drop of a hat (see also: Horse Armor). But for Valve to recognize that protest as valid and pull the plug so quickly *was* unusual. It had recognized something about mods that meant they shouldn't be sold, or at least not in the format it had done it. Much of it is to do with the complexity of "free"— what it means, and what license it gives to others.

So, we're going to explore the background to mods, why they're such a strange field—so amateur, but so important—and why Valve U-turned so quickly. Our guide is John Gibson, president of Tripwire Interactive, veteran modder, and the developer of *Red Orchestra*, which started life as an *Unreal* mod and is now a highly successful series of PC-only multiplayer shooters.

Modding in the early 2000s seemed an almost magical time,” starts Tripwire Interactive president John Gibson. “There were lots of great mods out that had done really well, like *Counter-Strike* and *Day of Defeat*; there were mods in development that would go on to be big successes, like *Desert Combat* and *Red Orchestra*. Back in those days, I really felt like you could create whatever your imagination and team’s talent could handle.”

The nostalgia is steaming off Gibson, but he’s right. The 2000s were the heyday. The scene, however, started with the bedroom revolution of the 1980s, when it was normal for programmers to share their code in magazines. Aspiring programmers could type it into their computers and play around with it to make their own games. That’s how many of the superstar creators of the 1990s learned their skills and got their inspiration. (It may also be why the early years were dominated by clones, because programmers had got so used to learning from each other’s code.)

By the late ’90s, several games had been released that supported modding, notably the id shooters created by John Carmack, *Doom* and *Quake*, which had easily acquired level editors. “Modding tools were common,” recalls Gibson, “but they're light years better now. If you were doing an *Unreal*, *Quake*, or *Half-Life* mod, you had source code and level editors, otherwise you’d have to hack into the files with hex editors etc. But the documentation was terrible. If you wanted to learn to code for modding, you’d just have to open up the source code and figure it out.”

> “Charging for mods shouldn't be a way for developers to exploit the work of modders.”

The next generation of games, *Half-Life* and *Unreal*, took it a step further, licensing their engine out for other games, or, in the case of *Unreal*, giving it away for free to non-commercial products. “They had a huge impact," says Gibson. "Even though we had what was at the time a massive mod team of 50 people, making a whole game engine just wouldn’t have been possible for us. We didn’t have the staff or the skill set to make a game engine, but we did have the talent to make a fun game. Off-the-shelf engines have been a great thing. So many great games have been made that would never have been made if it weren’t for engines like Unreal and others.”

Crucial was modding's egalitarianism. Not everyone could be a programmer or an artist, but almost anyone could muck around with level editors in *Quake* or *Doom*, even if, as Gibson says, the documentation was hard to find and guides harder still. That’s why modding was the precursor to indie development. Before easy-access free engines like Unity, modding was what you did to get into making games, to see your “imagination come to life on the screen.”

“Modding is the crucible where imagination and creativity can flow without the constraints of finances or profit,” says Gibson. “A lot of amazing, popular, or unique games have come out of the modding community. Without modding, there would be no *Counter-Strike*, *Dota 2*, *DayZ*, *Red Orchestra 1* or *2*, *Rising Storm*, *Killing Floor 1* or *2*, *Insurgency*, *Chivalry*… the list goes on.”

Gibson remembers his first mod was “an explosive that would blow up a submarine in a multiplayer map for the *Third Reich* mod for *Unreal Tournament ’99*. When I threw that grenade and watched that submarine blow up, I was hooked! I knew I’d found my calling. I just love making people happy and seeing them have fun with what I’ve created. In those early days, when we’d release a version of the mod, and see all the players on the servers, it was so exciting. Really, those are the same reasons I make video games today.”

VALVE'S WORKSHOP

Ever since the beginning, modding had been unstructured, with mods being found and installed on an ad hoc basis. Very few games had anything like a client to support mods, let alone an official one. Even now, games with a built-in mod browser, like *Civilization V*, are few and far between.

“The biggest problem was getting mods into people’s hands, and keeping everyone on the same version,” says Gibson. “People had to download files from all kinds of sources.” At that time, sources like GameSpy allowed players to organize multiplayer matches, while sites like FilePlanet would host the files. Attempting to play a mod for, say, *Half-Life*, could be a frustrating loop of attempting to load the game, finding out the nearest servers were limited to certain mods, and discovering where to download the latest builds from, before returning to the server to learn it had moved on to another mod that you still didn’t have. And all this on dial-up modem speeds…

In the light of all that, Valve’s 2011 introduction of the Steam Workshop was a revelation. It allowed any user to upload a mod and anyone else to download it and rate it. This meant poor-quality mods were filtered out. Gibson thinks it’s a great tool and a great way to get smaller mods into the hands of players, given its 100MB file size limit (soon to be removed for *Skyrim* mods on Steam). “I would love to see Steam develop better support for getting total conversions and larger mods into the hands of gamers. The file-size limits, for example, make it really hard. Right now, Steam works really well for getting mods that are hats and swords into player’s hands for free, and for getting large mods to go commercial through Greenlight.”

THE PAID-MODS DEBACLE

However, Steam’s new move in 2015 was to allow people to sell mods of other people’s games, starting with *Skyrim*, a fine-line distinction between selling a mod-derived game but one that some of the PC gaming community took umbrage at.

Garry Newman, creator of *Garry’s Mod*, voiced their concerns: “I like the idea that someone could spend months working on a mod, then making enough money out of it to give up their job and work on it full-time. I don’t like the idea that someone could spend a day making a crowbar model and ask people to pay for it. That was the impression the *Skyrim* stuff gave. It didn’t show how users would get better mods, it showed how they’d be paying for what they already were getting for free.” He was also querulous over the 75 percent cut Bethesda was taking. “Charging for mods should really be a way of empowering the modding community, not a way for developers to exploit the hard work of modders to make money.”

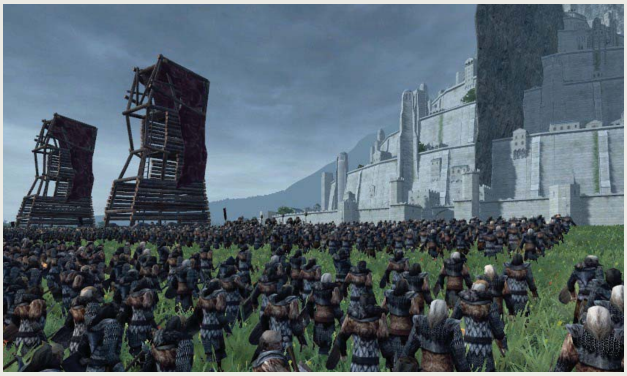
Gibson himself is responsible for commercial mod-derived games like *Garry’s Mod* appearing on Steam in the first place. “I had this crazy idea in 2005 to contact Valve and see if they would sell the commercial version of *Red Orchestra* on Steam. I know it seems commonplace now, but Valve wasn’t even selling third-party games on Steam back then, let alone mods going commercial. Fortunately, I was able to get in touch with Doug Lombardi, and they’d heard of our mod and were interested. I think that was a landmark moment for modders and independent developers. There was finally a way to get our games in the hands of gamers without a big publisher. These days, with things like Steam Greenlight and Early Access, Humble Bundle, making the jump from mod to commercial game is a lot easier.”

It seems odd that, in our capitalist society, there should be an argument about whether people who want to sell something, should be able to. But then the Internet starts from a philosophy of anarchy. The argument is more complicated than “if people want to have something, they should be able to,” but not much more so. The balance is between modders making money, the original dev taking a cut, and the public getting bug-free mods and total conversions.

Many more famous modders, who’ve already transitioned to paid-for games, came out in favor of the change. Dean Hall, of *DayZ*, said: “I believe it will be good for the modding

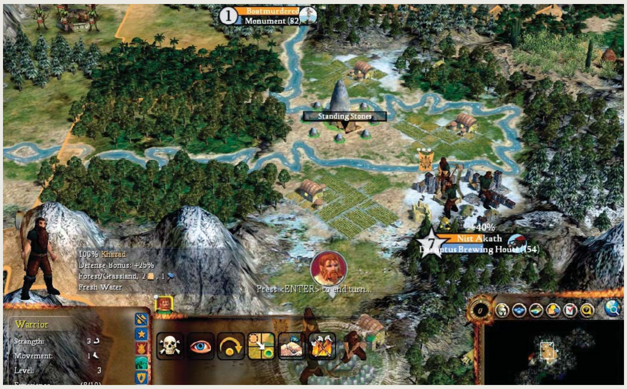
BEST TOTAL CONVERSIONS

Forget the extra hats. Which mods have most radically transformed whole games?



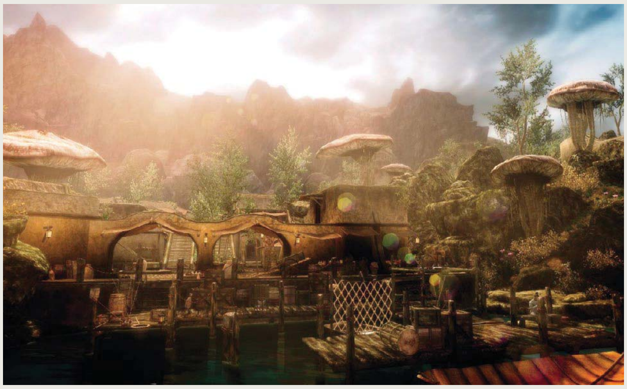
The Third Age: Total War 2013

A terrifyingly comprehensive and polished *Lord of the Rings* conversion for *Medieval 2: Total War Kingdoms*, which features a dozen factions and a hundred locations from the books, as well as orcs, trolls, wargs, and the rest.



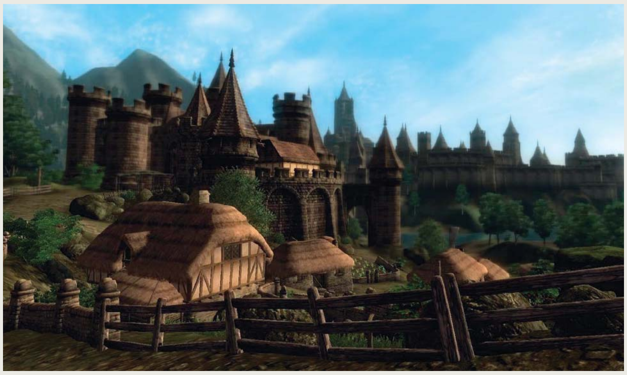
Fall From Heaven

Now 10 years old, this mod for *Civilization IV* is a dark fantasy game based loosely on *D&D*. Players control a human race after an apocalypse. It introduces spellcasting units, unique Heroes, Angelic, Elven, Dwarven, and Demonic civilizations to encounter, plus strange religions.



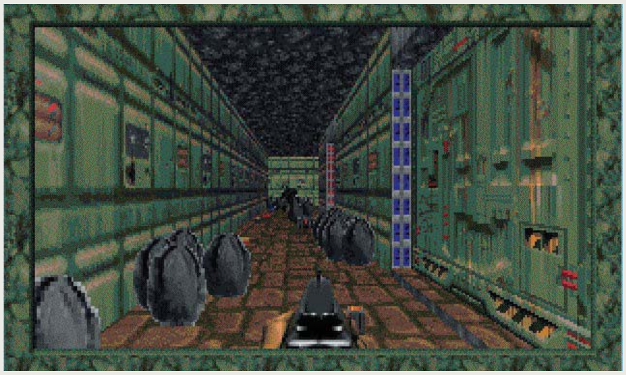
Skywind

Morrowind was the game that had most gamers fall in love with the *Elder Scrolls* series, but it looks ugly by today's standards, and has some unforgiving mechanics. Enter *Skywind*. Currently still in alpha, it promises a total rebuild of *Morrowind* in the *Skyrim* engine.



Nehrim: At Fate's Edge

A total conversion for *The Elder Scrolls IV: Oblivion* by the semi-pro mod team SureAI, *Nehrim* took four years to make, providing an entire new world to explore, new races, and a voice-acted main plot. SureAI has also produced two *Morrowind* mods, one *Fallout 3* mod, and it's now working on *Skyrim* total conversion *Enderal: The Shards of Order*.



Aliens

The first total conversion, this altered the textures and enemies of *Doom* to that of the *Aliens* movie, and built an all-new world. It was so successful that creator Justin Fisher was offered a job by several studios, but finished his degree instead. (One of those studios, Dreamworks, made a game called *Trespasser*, inspired by Fisher's mod.)

THE GENRE BUSTERS

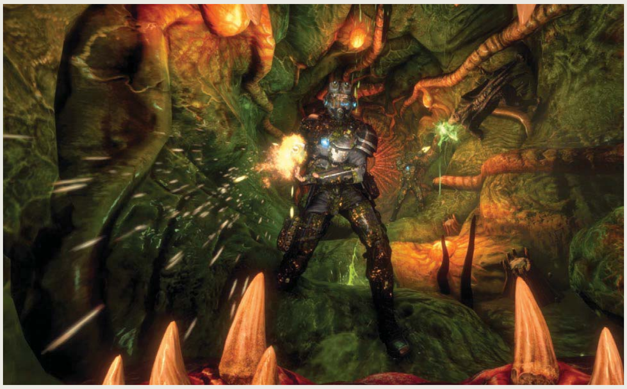
The genuine game changers born from the creative world of modding

The Stanley Parable

A series of choices leads you down a random set of paths, through obstacle courses, narrative foibles, a nuclear countdown, and a *Minecraft* parody. No other *Half-Life* mod has the same hubris, humor, and haphazard happenstance.

Dear Esther

Dan Pinchbeck's mod was more about atmosphere than doing anything, but it's possibly the most beautiful first-person game around. Players wander an abandoned island while a narrator talks about his failed life and a ghost story unfolds. It's being rebuilt to be even more stunning.



Natural Selection

Multiplayer mash-ups of *Counter-Strike* and *Starcraft*, *Natural Selection 1* and *2* are first-person shooters with real-time strategy elements. One player on each team is a commander, who looks down on the battlefield and deploys abilities. It started out as a *Half-Life* mod.

Garry's Mod

Making its creator, Garry Newman, a multi-millionaire, his mod was and is a multiplayer sandbox that allows players to mess around with the tools and creatures from the *Half-Life* universe. It's based around building, rather than winning and losing in the traditional gaming sense. It's also got a secondary use as an excellent animation studio.

Black Mesa

Isn't this just *Half-Life 1* told through the *Half-Life 2* engine? Yes, but the fact that Valve has allowed the modder to sell it on Steam is the amazing thing, opening up the market to modders doing commercial remakes of older games, for sale on Steam. Now, if only EA would open up its back catalog to modders and indies....

community; it will provide a baseline way of generating money, but I do not think it will provide an end-state for the larger mods. Making money from content creation is complex, and there are different avenues for different games. I think professional modding is a natural evolution for content creation."

The transaction should be that, with paid-for mods, the consumer gets more choice and better support in return for payments. Gibson mostly agrees: "If you're selling something, you're obligated to deliver something that works, is fun, and isn't full of serious bugs. Really, it took us a few games to realize this, as our rough launch of *Red Orchestra 2* can attest. Fortunately, we stood by our game, fixed it, and supported it for years. And now we're *a lot* more careful of what we pass off to gamers to sell, even if it's Early Access."

For modders, what they get from paid mods is money, which allows them to make it a career, in the same way that digital distribution allowed indie developers to change from making free games to publishing full titles on Steam. As Dan Pinchbeck, creator of *Dear Esther*, said: "The issue is less about whether or not talented content creators should be able to get an income. That's a no-brainer, of course they should. The problem is how you curate this. Early Access and pre-alpha purchasing has resulted in stores being flooded with cynical, poor-quality products that make it harder for genuinely great games to get discovered."

That's part of the problem. Some modders might not want the increased obligations—improved support, bug fixing, full testing, and so on—in return for a mere 25 percent of the revenue. Generally, if they're still modding after all these years, rather than having moved into potentially profitable indie development, they're likely to be determined amateurs, more resistant to change anyway. And this is a big, big change. Similarly, for Valve and the developers, it does mean more money, and more longevity for existing games. But there are negatives as well—babysitting modders, ensuring communities are supported, and that pirated mods are policed. It demands time, money, and people.

Anyway, the feature was short-lived. Within a couple of days, it disappeared, to be replaced by a message from Valve's Alden Kroll: "Our main goals were to allow mod makers the opportunity to work on their mods full time, and to encourage developers to provide better support. We thought this would result in better mods for everyone, both free and paid. We wanted more great mods becoming great products, like *Dota*, *Counter-Strike*, *DayZ*, and *Killing Floor*.

"But we underestimated the differences between our previously successful revenue-sharing models, and the addition of paid mods to *Skyrim*'s workshop. We understand our own game's communities pretty well, but stepping into an established, years-old modding community in *Skyrim* was probably not the right place to start iterating. We think this made us miss the mark pretty badly, even though we believe there's a useful feature somewhere here."

INTO THE FUTURE

Modding is changing. Despite running a successful game company, Gibson still has that modding itch, and still makes mods in his spare time. "I put out a free mod for *Killing Floor* called *Gun Game*, and have developed a mod for *Red Orchestra 2* that hasn't seen the light of day yet. Our art director David Hensley made a mod for *Killing Floor* called *Toy Master* that had unique characters and levels. It's fun to step out of the constraints of a commercial project from time to time and just do whatever your imagination tells you to do."

Gibson's company, Tripwire, was among the first to support official mods on Steam, and both *Killing Floor* and *Red Orchestra 2* have Steam Workshop support. "All of our games have mod SDKs. We do modding competitions to foster the community. We work behind the scenes to support the development of mods for our games. To us, supporting modding is one of the best things that you can do for your game."

Yet the type of mods that Gibson started on, the multiplayer total conversions, aren't being made so much anymore because of shifting commercial pressures. "I think a lot of people are making hats for *TF2*, or swords for *Skyrim*, instead of making total conversion mods. I'd love to see some great total conversions come out. The last round of really great ones—*Age of Chivalry*, *Insurgency*, *DayZ*—have all gone commercial now."

That's because, for many people, modding isn't as attractive as it used to be. Aside from the benefits of commercial mod development, the rise of indie game development has pulled a lot of the talent from the mod community. The lack of standard tools and documentation in modding compares poorly with indie game development's access to easy and free tools, plus tutorials and guides.

"A lot of people that would have been modders in the past start making commercial indie game projects right away," agrees Gibson. "I'm not sure if this is good or bad. You learn a lot putting out free mods and having that development cycle and interaction with the community when you release the mod and update it. And if the mod stinks, well, no one paid for it. So you gain precious skills as a modder that I think in some ways people are now learning at the expense of game buyers. With that said, I love that there are so many great indie games out there that give people options beyond the big AAA games that have to earn gazillions to be worth making."

THE BIGGEST GAMES

Counter-Strike

Valve's hugely successful shooter started life as a mod to *Half-Life*. Each game is almost identical, save for improved back-end systems and looks. Every game features terrorists versus counter-terrorists.

Dota 2 / League of Legends

The original *Dota* was a mod to Blizzard's *Warcraft III*. Called *Defense of the Ancients*, the game gave each player control of one hero. Huge viral popularity followed. *Demigod* was the first copy, with *League of Legends* cloning it, and *Dota 2* improving on it.

DayZ

Zombie mods for Bohemia's games weren't new—its original *Operation Flashpoint* games supported several—but Dean Hall's zombie survival simulator added the twist of human players being the biggest enemy, with zombies being almost incidental.

Team Fortress

Valve's other hugely successful multiplayer shooter started life as a mod for *Quake*. Its innovative class system and hardcore team action ensured an audience, even on dial-up modems. It was the first Steam game to allow modders to make money.

UFC
3
BUD LIGHT
GRAND
MGM

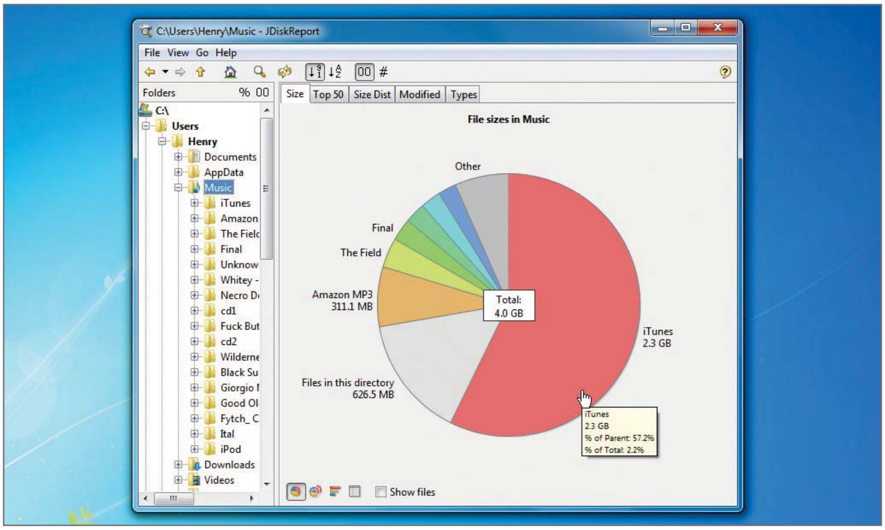
SUBSCRIBE

GO TO UFC.COM/MAGAZINE
TO SUBSCRIBE NOW!

HOW TO

STEP-BY-STEP GUIDES TO IMPROVING YOUR PC

WINDOWS TIP OF THE MONTH


C:\Users\Henry\Music - JDiskReport
File View Go Help
Folders
C:\
Users
Henry
Documents
AppData
Music
iTunes
Amazon
The Field
Final
Downloads
Videos
Size
Top 50
Size Dist
Modified
Types
File sizes in Music
Other
Final
The Field
Amazon MP3 311.1 MB
Total: 4.0 GB
iTunes 2.3 GB
Files in this directory 626.5 MB
iTunes 2.3 GB % of Parent: 57.2% % of Total: 2.2%
Show files

CLEAR YOUR HARD DRIVE CLUTTER

Disk Cleanup is great for deleting unused files, but it can't detect what's eating up space. JDiskReport solves this by showing the biggest files. Download it at http://bit.ly/1zZE8dE, and use "Scan a file tree" to choose where to look. You'll see a pie chart showing where large files are lurking. Right-click a slice and click "Open Explorer" to zap those huge files.

MAKE – USE – CREATE

60
Create a 3D game with Unity

64
Stay secure with Heimdal

66
Build an ultra-budget gaming PC

GRAHAM BARLOW
CONTRIBUTING EDITOR

MICROSOFT HEADS FOR THE EDGE!

So, the name Project Spartan is no more. The next version of Internet Explorer is going to be called, simply, Edge. That's much less geeky, a good move Microsoft. As a fan of distorted guitar effects pedals and hiding my receding hairline under beanies, I'm stoked. But any resemblance to members of U2 have turned out to be greatly exaggerated. Except that it comes pre-installed as part of Win10. Clearly, Microsoft has taken a leaf out of Apple's book, when it delivered a mandatory U2 album to its iTunes customers last year.

Watch the trailer (yes, web browsers have trailers now), at http://bit.ly/1JTo2Sf, and you'll see Edge looks pretty amazing. At least you can now draw little doodles over things on Amazon, and Cortana for voice search looks baked in. Maybe I'll switch to Edge when Win10 is released and I'm enjoying my free upgrade, but it's going to take a lot to drag me away from Chrome. However, the announcement that Edge will be able to use Chrome extensions could just do it. If you haven't used Chrome extensions before, visit http://bit.ly/1cqwJoZ to see what you're missing. Without them, browsing would be much less fun for me, and this could be key to Microsoft getting me to switch.

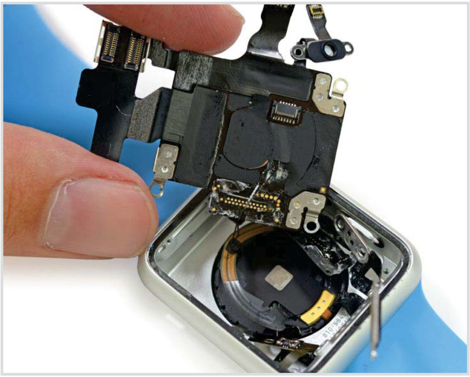
↘ submit your How To project idea to: comments@maximumpc.com

IFIXIT presents:

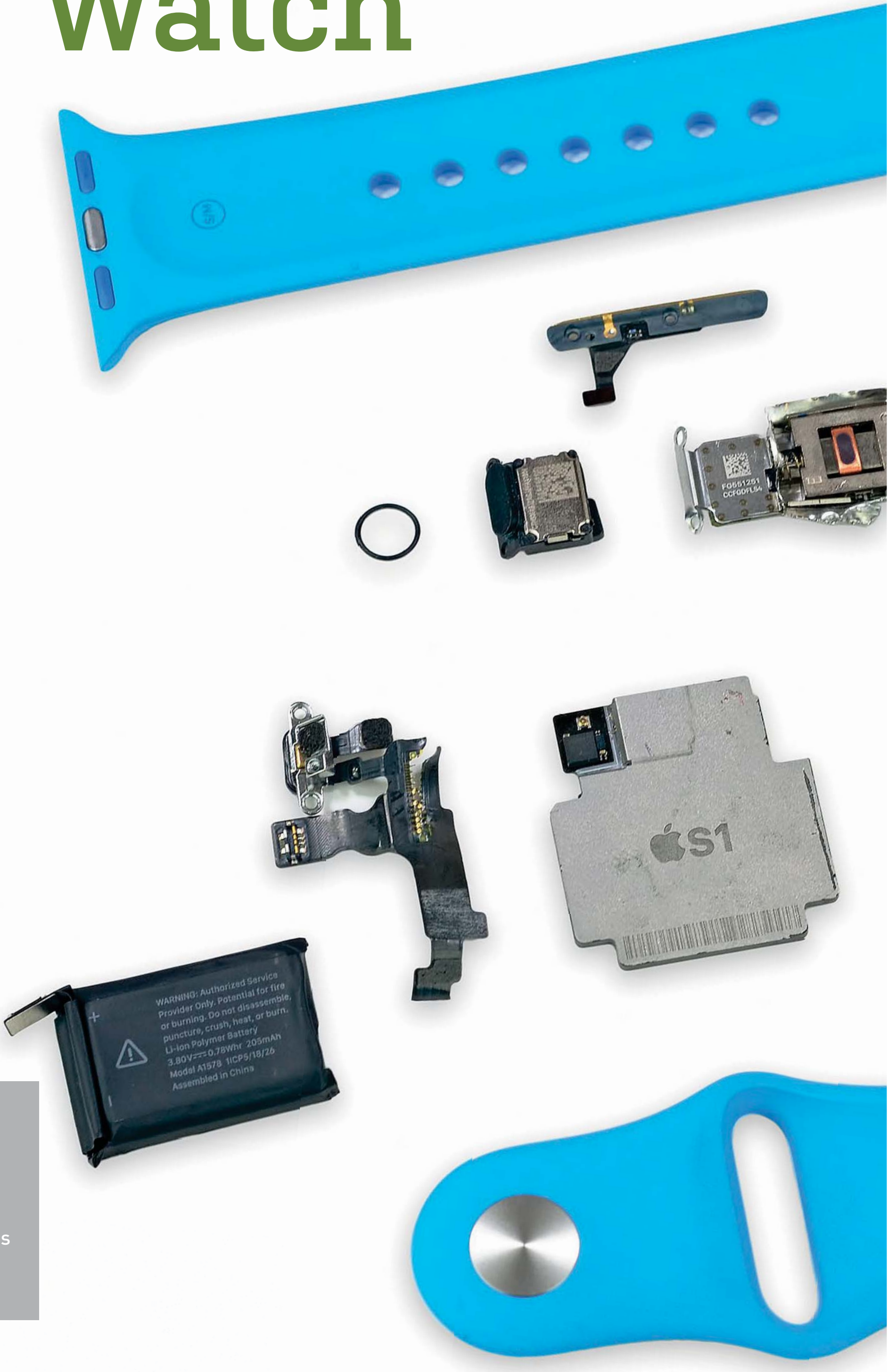
AUTOPSY

THIS MONTH WE DISSECT...

Apple Watch Sport

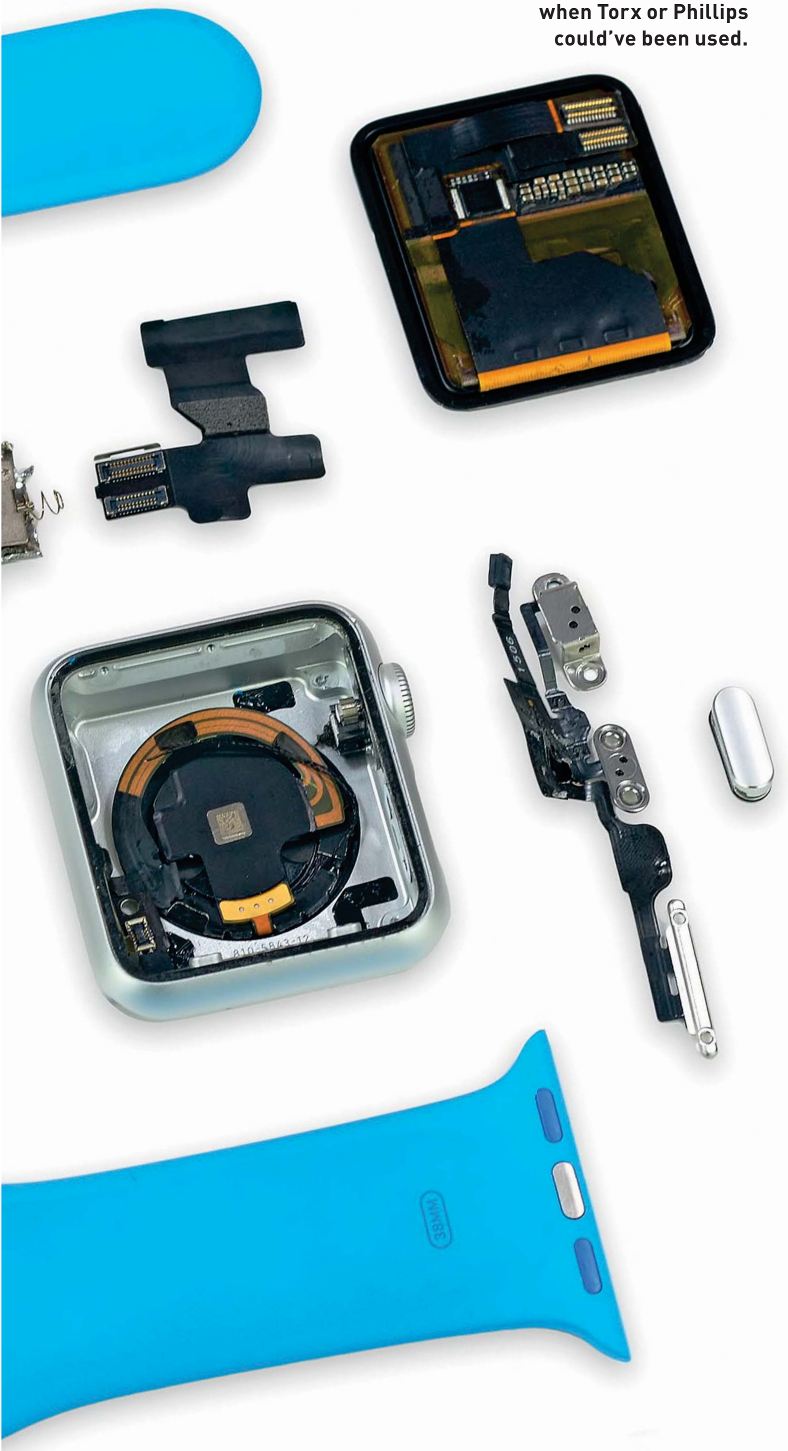


The difficulty of removing the S1 casts serious doubt on the idea of swapping out the internals.


S1
WARNING: Authorized Service Provider Only. Potential for fire or burning. Do not disassemble, puncture, crush, heat, or burn.
Li-ion Polymer Battery
3.80V⎓0.78Whr 205mAh
Model A1578 1ICP5/18/26
Assembled in China

About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit www.ifixit.com.



Apple has annoyingly used incredibly tiny tri-wing screws, when Torx or Phillips could've been used.

BACKGROUND:

You may have heard of the Apple Watch. Apparently, there's been some hype. You may also have heard about the IHS Technology report, which claimed hardware costs only account for 24 percent, or $83, of the Watch's $349 retail price. So, is Cupertino's latest something to get excited about?

MAJOR TECH SPECS:

- Flexible, touchscreen AMOLED Retina display
- Custom-designed Apple S1 SiP (System in Package)
- 8GB onboard storage, Watch OS
- NFC, Wi-Fi 802.11b/g/n, Bluetooth 4.0
- Accelerometer, gyroscope, heart rate monitor, mic, speaker

KEY FINDINGS:

- If you're looking forward to swapping out bands, there's not much to it. A button on the back case releases a spring-loaded metal peg in the band, allowing it to slide right out. There are no external screws, however, so we reattach the band for leverage and use a knife to get inside the belly.
- Disconnecting the display isn't easy, as the display cables are trapped under a springy bracket. A quick flick dispatches the light adhesive securing the 3.8V, 0.78Wh lithium-ion battery. Apple claims the 205mAh battery should provide up to 18 hours of use. It seems small in comparison to the 300mAh batteries found in the Moto 360 and Samsung Gear Live.
- We encounter the tiniest tri-wing screws we've ever seen, before getting to the speaker, which comes equipped with an O-ring for water resistance. Behind a very small panel we find a set of contacts that align perfectly with the location of the hidden diagnostic port. We remove the Digital Crown bracket, the final obstacle keeping us from the S1 SiP.
- The back of the S1 isn't pretty—with ribbon cables running to every peripheral and gobs of adhesive gripping it in place. Pulling this mess out is destructive. It's a solid block of plasticky resin, hiding treasures deep within, such as the STMicroelectronics C451 gyroscope and accelerometer.
- Back to the display panel, we find a lonesome chip: Analog Devices AD7166 ARM Cortex M3-based Touchscreen Controller. At the bottom is the pulse-pounding sensor action. And lenses. Apple's heart rate monitor is actually a plethysmograph—it looks and acts like a pulse oximeter.
- Repairability Score: 5 out of 10 (10 is easiest to repair). The band is easily removed and swapped. Removing the screen is difficult, but not impossible. Once inside, the battery is quite easy to remove—only mild adhesive holds it in place. While not proprietary, incredibly tiny tri-wing screws are a repair hinderance. Removing any other component is essentially impossible—all peripheral cables are soldered onto the back of the S1. The fully encased S1 system makes board-level repairs impossible.

Create a 3D Game with Unity

YOU'LL NEED THIS

UNITY PERSONAL EDITION

Download Unity 5 Personal Edition and the Standard Assets pack, for free, from http://unity3d.com.

DEVELOPING GAMES ISN'T EASY. At least that's the general perception. And it's true if you're talking about creating a game from scratch in a general-purpose programming language. But these days, it doesn't have to be anything like that hard. There are tools available that happen to cost absolutely nothing, and which make the whole process of creating a game a pleasure, rather than a chore. Almost a game in itself. Unity, as an example, offers the kind of graphical interface that you'd more commonly find in a simple-to-use 3D modeling tool, with cameras, light sources, and models. You can have something impressive up and running in a matter of minutes, as we're going to show you here. –**ROBIN DE JONGH**

1 GAME ON

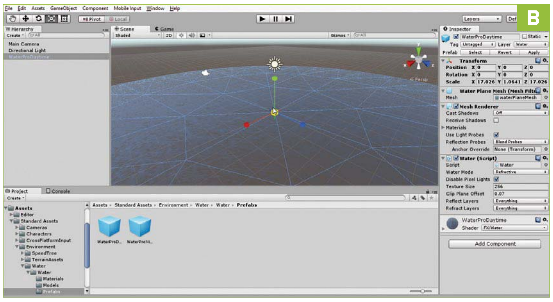
Unity Personal Edition is free from http://unity3d.com. Once you've installed it, open Unity and hit "New Project." Name your project "IslandRun," and in the same screen click the "Asset Packages" button. Tick the boxes for "Cameras," "Characters," "Environment," and "Vehicles" packages, and click "Done," then "Create Project." Your game assets library will take a while to load and the progress bar will show how far you have to go.

» Once in the Unity Editor, you'll see a screen similar to any 3D modeling package. On the top, you have the main scene into which you'll place your 3D or 2D objects. You could create these yourself, using tools such as Gimp and Blender and import them, but in this tutorial we'll be using pre-made assets from the Libraries you just loaded. Think of the Scene view as a film set on which you assemble the components prior to a take.

2 SETTING THE SCENE

If you click the tab above the scene view, labeled "Game," the window will change to the game view. Continuing the analogy of a film set, the game view shows you only what the audience will see. Click the "Scene" tab before continuing. Next to these windows, on the left, is a list of everything that's currently in the scene. Think of this as your stagehand's list. If you click the camera in the list, it will highlight the camera in your scene.

» Typing "cam" into the search field at the top will isolate anything on the list with those letters in it, making it an extremely useful way to find things in your scene if it gets crowded. On the far-right of the screen is the Inspector [**Image A**], which will show details of the Camera you selected. Delete the letter from the search box and then select "Directional Light" in your Hierarchy list. You will see that the details change to those more specific to your lighting.



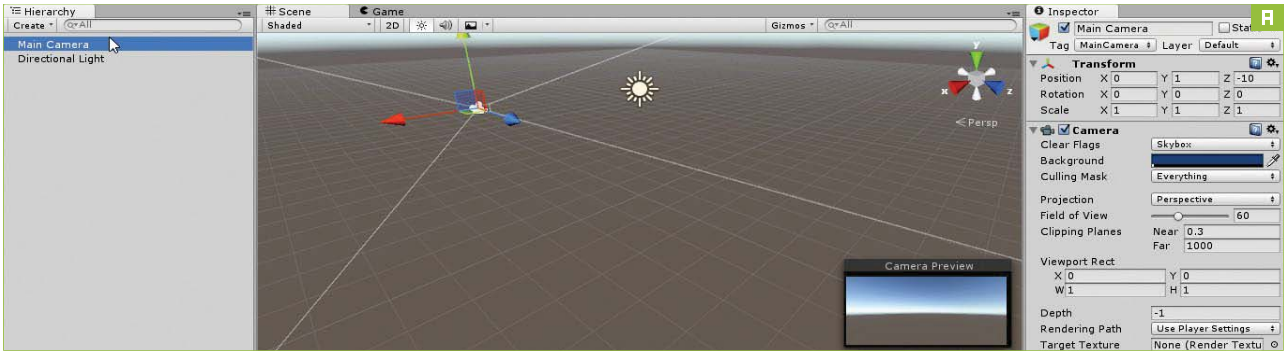
3 WATERWORLD

There's nothing to see at the moment, so let's get on with some world building. One of the simplest but most effective things to do it to is to start with water—it provides visual interest and some natural edges.

» Below the scene window is a project list, containing all the game assets you've loaded into the project. Select "Standard Assets → Environment → Water → Water → Prefabs," then drag the "WaterProDaytime" item into your Hierarchy list. It will now appear in your scene. Above-left of the scene window, you have five buttons. Select the fourth one in. Click the little box at the center of the "Water" prefab, hold down the left mouse button and move up. This scales the water up. Do this a few times [**Image B**].

4 WAVE MACHINE

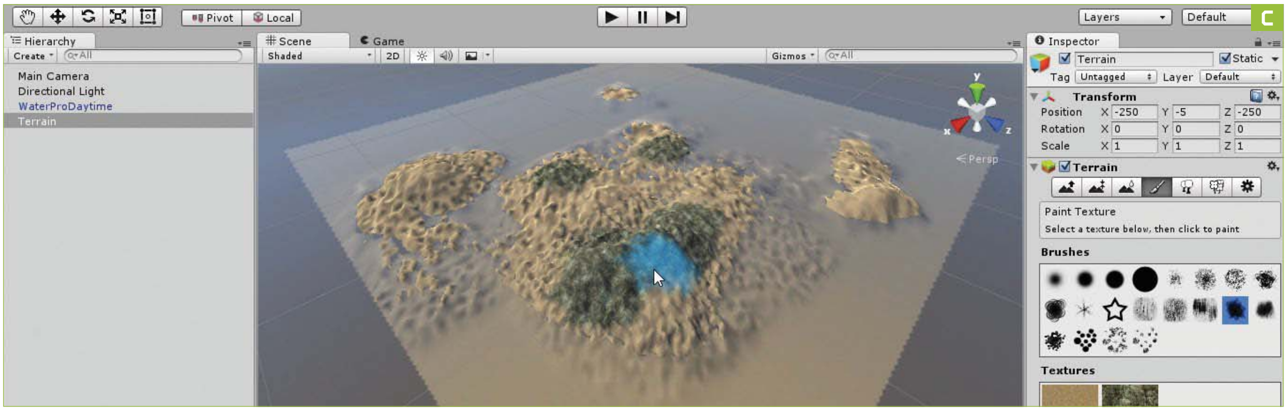
The Water prefab you've inserted in your scene is a flat disc with a Material already applied to it. (For more about materials, see "How Materials Work," opposite). Click the "Play" button at the top-center of your



Main Camera ☑ ☐ Static
Tag MainCamera Layer Default

Transform
Position X 0 Y 1 Z -10
Rotation X 0 Y 0 Z 0
Scale X 1 Y 1 Z 1

☑ Camera
Clear Flags Skybox
Background
Culling Mask Everything
Projection Perspective
Field of View 60
Clipping Planes Near 0.3
Far 1000
Viewport Rect
X 0 Y 0
W 1 H 1
Depth -1
Rendering Path Use Player Settings
Target Texture None (Render Textu



Terrain ☑ Static
Tag Untagged Layer Default
Position X -250 Y -5 Z -250
Rotation X 0 Y 0 Z 0
Scale X 1 Y 1 Z 1
☑ Terrain

screen and see what else it has to offer. Did you notice when you hit "Play" that Unity executes a script that animates the bumpiness of the waves? So, what we have so far is a camera view that remains static, pointed at the horizon of a scene that has one light in it, a skybox that simulates diffused light from the sky, and a flat plane with water material applied. Finally, a script attached to the water makes the waves animate over time. Go to "File → Save Scene," and type "IslandRun_Scene" and hit "Save."

5 CREATING THE ISLAND TERRAIN

Unity comes with terrain-editing tools that we'll now use to create an island. Go to "Game Object → 3d Object → Terrain." In the Inspector, enter "X -250," "Y -5," and "Z -250." This places the terrain at the center of the Water, since the terrain defaults to a 500-wide square. The "-5" in the Y axis allows the water to be above the terrain.

» At this stage, increase the water, too, so that it stretches out further than the terrain. Select it and enter "X 1000" and "Z 1000." We'll now raise various parts of the terrain to create an island. With the "Terrain" selected, click the "Raise/Lower Terrain" button. Select one of the rough brushes and increase its size to "100" and Opacity to "50." Paint onto the Terrain the general shape of your Island.

» Next, reduce the brush size and opacity, then repeat to add in medium detail. Finally, use the "Smooth Height" feature if you have a terrain that's too bumpy. Use the scroll button to zoom in and out and the middle mouse button to pan around the view. Click the "Paint Texture" button and select "Edit Textures" and "Add Texture."

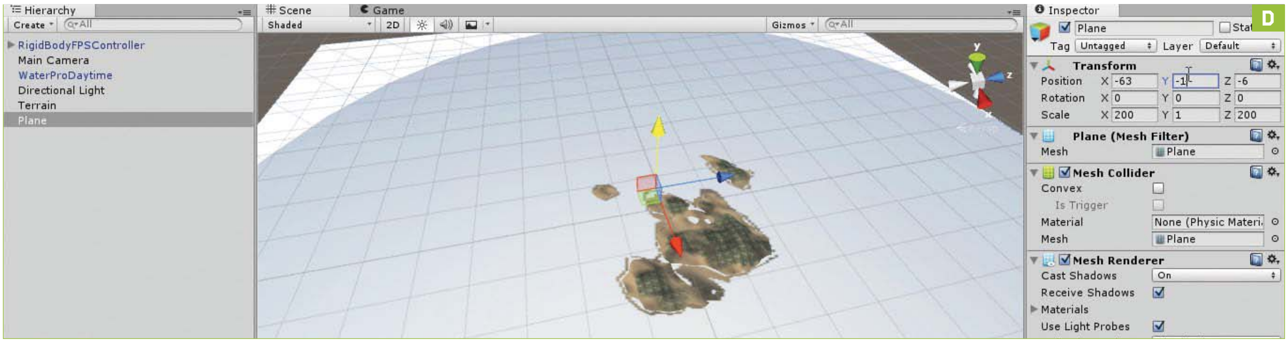
» To apply and paint textures to your island, click "Select" on the left-hand square labeled "Albedo (RGB)." Scroll down to find "SandAlbedo" and double-click. Select "Add." You'll notice that sand has been applied to your whole Terrain. Now add another Texture in the same way, selecting any of the "Cliff" or "Rocky" textures. Now, select it and use brushes in the same way as before to paint over the top of the sandy terrain wherever you want rock to poke through [**Image C**].

HOW MATERIALS WORK

Game graphics have improved hugely over the years, but the basic format has stayed the same. Objects are made up of meshes, which in turn are made up of polygons, usually triangles or quads. Think of these as chicken mesh bent into shape with papier mache over the top. You get a 3D shape, but no detail or color onto which materials are applied. Materials start with a texture, which is called Albedo in Unity 5. It has the basic color information in it.

Added to this are extras, such as a Normal map, which defines details such as grooves, cracks, bumps, and scratches. A material might also have an ambient occlusion map, which tells Unity where areas of constant shadow are, or a specular map, which controls which part of the material looks shiny. A height map is used in materials such as the terrain for our game, where elevation is controlled by the level of gray in a grayscale image. For the full lowdown, see the great primer prepared by the Unity team at http://bit.ly/1zMyBHc, or the more advanced http://bit.ly/17Tedr9.

Unity 5 has a stunning demo scene to help understand materials and lighting.


D
Hierarchy
Create
RigidBodyFPSController
Main Camera
WaterProDaytime
Directional Light
Terrain
Plane
Scene
Game
Shaded
2D
Gizmos
Inspector

☑ Plane ☐ Stat
Tag Untagged Layer Default

Transform
Position X -63 Y -1 Z -6
Rotation X 0 Y 0 Z 0
Scale X 200 Y 1 Z 200

Plane (Mesh Filter)
Mesh Plane

☑ **Mesh Collider**
Convex ☐
Is Trigger ☐
Material None (Physic Materi.
Mesh Plane

☑ **Mesh Renderer**
Cast Shadows On
Receive Shadows ☑
Materials
Use Light Probes ☑

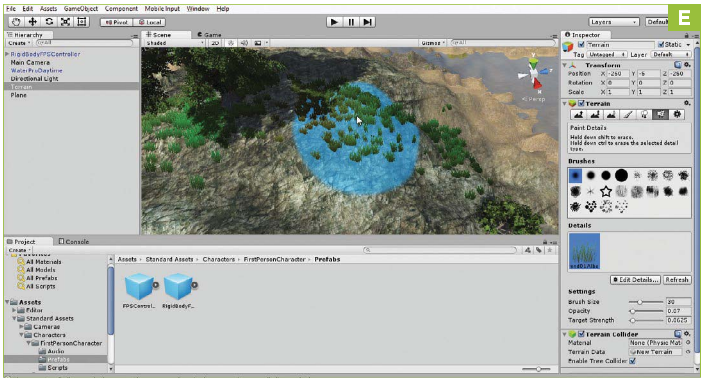
6 ADDING THE PLAYER

Let's add a "Player Controller" so that we can walk around. In the "Project" tab, go to "Assets → Standard Assets → Characters → FirstPersonCharacter → Prefabs," and drag the "RigidBody" controller onto your Terrain. Zoom with the "Move" button selected (top-left of the screen, second button in), pull the yellow axis up until the green bounding box just clears the ground.

» It's time for a test drive! Click the "Game" tab and hit "Play." If your character falls through the floor, go back to Scene and move the player prefab up a little more. When you press "Play," you should be able to walk around your island enjoying the view.

» You may notice the player can walk into water and disappear. Add another "3D Object," this time selecting "Plane." Scale it "200" in X and Z, then set the Transform of Y to "-1," taking it just below the water [**Image D**]. Tick "Mesh Collider," but untick "Mesh Renderer." We've now created an invisible Plane just under the water, with a Collider set just to stop anything going under the water.

» Now to add trees. In the Terrain section in the Explorer, select "Place Trees" and click "Edit Trees → Add Tree." Click the circle in the Add Tree dialog box. Select "Broadleaf Desktop" and click "Add." Set Brush Size to "20" and Tree Density to "50." Paint onto the terrain where you want trees to be.


E
File Edit Assets GameObject Component Mobile Input Window Help
Pivot
Local
Layers
Default
Hierarchy
Create
RigidBodyFPSController
Main Camera
WaterProDaytime
Directional Light
Terrain
Plane
Scene
Game
Shaded
2D
Gizmos
Persp
Project
Console
Create
All Materials
All Models
All Prefabs
All Scripts
Assets
Editor
Standard Assets
Cameras
Characters
FirstPersonCharacter
Audio
Prefabs
Scripts
Assets › Standard Assets › Characters › FirstPersonCharacter › Prefabs
FPSControl...
RigidBodyF...
Inspector

☑ Terrain ☑ Static
Tag Untagged Layer Default

Transform
Position X -250 Y -5 Z -250
Rotation X 0 Y 0 Z 0
Scale X 1 Y 1 Z 1

☑ **Terrain**

Paint Details
Hold down shift to erase.
Hold down ctrl to erase the selected detail type.

Brushes

Details

Edit Details... Refresh

Settings
Brush Size 30
Opacity 0.07
Target Strength 0.0625

☑ **Terrain Collider**
Material None (Physic Mat
Terrain Data New Terrain
Enable Tree Collider ☑

» Go to "Paint Details." Click "Edit Details" and "Add Grass Texture." Click the circle and double-click on a "GrassFrond" texture. Select "Healthy Color" and make it a little less luminous. Do the same with "Dry Color." Click "Add." Change "Brush Size," "Opacity," and "Target Strength" to "30," "0.07," and "0.07," respectively.

» Use the brushes as before and lay down grass wherever you want [**Image E**]. Try your game and see how it looks, then go back and add more or remove some by holding Shift while painting. One thing to bear in mind is that grass only shows up when you're near it.

7 SETTING UP THE HUNTER

We're going to add an enemy aircraft to hunt the player. This aircraft will home in on the player rig, so they'll have to keep moving. Go to "Standard Assets" again and find the "Aircraft" prefabs. Drag the "AircraftJetAI" or "AircraftPropellerAI" into your "Hierarchy" tab. Double-click on it to center the view on it.

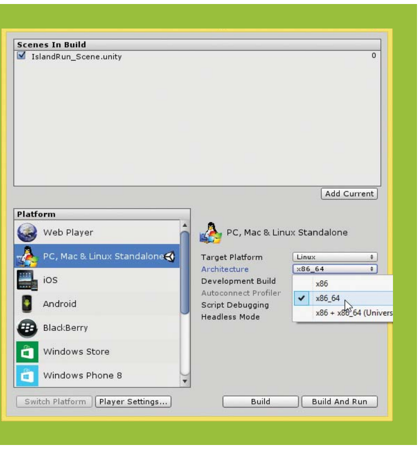
» Use the "Translate" button (top-left, second button) to move the craft up above the water and away out to sea. In the Inspector section, scroll down to "Aeroplane AI Control," and then select the circle by Target. Select "RigidBodyFPSController." Back in the Inspector, untick "Waypoint Progress Tracker."

» Try out the game. The Aircraft will come for you and probably crash. To fix this, select your invisible "Plane" and right-click, then "Duplicate." Move the copy to "Y 35," or whatever works for your terrain. Switch on the "Mesh Renderer" temporarily to see the plane and ensure it clears the top of each peak of your terrain.

BUILT TO GAME

Your game should now be ready to try out outside of the Unity development environment. Save the "Scene" and "Project." Now go to "File → Build Settings." Select "PC Mac & Linux Standalone." Select the Target Platform as "Windows," and select whether you want x86 for 32-bit machines or x86_64 for 64-bit systems.

Click "Add Current" to add your Island Scene to the build. Click "Player Settings." Enter your company name and any other details you wish, such as a splash screen. Click "Build" and type in your filename and click "Save." Once created, copy the executable to your test machine (we wouldn't recommend running it straight from a USB stick), and simply double-click it to launch your game to see if it works. That's all there is to it. Game on!


Scenes In Build
Add Current
Platform
Web Player
PC, Mac & Linux Standalone
iOS
Android
BlackBerry
Windows Store
Windows Phone 8
Switch Platform
Player Settings...
Build
Build And Run

☑ IslandRun_Scene.unity 0

PC, Mac & Linux Standalone
Target Platform Linux
Architecture x86_64
Development Build
Autoconnect Profiler
Script Debugging
Headless Mode

x86
✓ x86_64
x86 + x86_64 (Univers

The export possibilities for your game are impressive, but choose wisely.

Give Photos a Vintage Look

YOU'LL NEED THIS

VINTAGER
Give your photos a classic, old-fashioned feel with this free, third-party tool. Download it at http://bit.ly/1EX1mku.

NOSTALGIA REALLY ISN'T WHAT IT USED TO BE, particularly where photos are concerned. Dig out old pictures, and the signs of aging all add extra charm and ambience to the scenes they portray. Modern digital photos aren't subject to the ravages of time, but thanks to a great free tool, called Vintager, you can inject some nostalgia into your recent snaps, and see how they might have aged had they been shot on film.

It's simple to use: Vintager gives you a choice of 17 filters to try. Many apply different colored filters to inject some age and washed-out ambience, such as Blossom, Coconut, or Mint. Others go further. Candela adds a layer of artificial scratches, while Billie ages the photo by darkening it. You can then fine-tune these settings to get the perfect shot. Read on to find out how. –NICK PEERS

1 SELECT PHOTOS TO AGE

Point your browser at www.exeone.com/vintager to download and install Vintager. Once installed, leave "Launch Vintager" ticked, and click "Finish." When the main window opens, click the folder button next to "Image," to pick the photo or photos you want to edit. If editing multiple photos, hold Ctrl as you select each one. Click "Open" when you're done.

2 CROP, ROTATE, RESIZE

The first of your selected photos will appear in the preview window. Use the "Crop" tab to select part of the photo if you want to focus on a specific part of the image. Use the "Rotate" tab to spin or flip the image, and finally the "Resize" tab to shrink the size of the finished photo. Click the anchor button before you begin to preserve its aspect ratio.

3 APPLY EFFECT

Now click one of the five preset buttons beneath the editing controls to apply an aging effect—more effects are hidden away, so use the arrow to the right of the preset to navigate between them all. Once you've found an effect you like, use the Color adjustment tab's "Brightness" and "Contrast" sliders to fine-tune.

4 FRAME AND APPLY

Switch back to the first tab. Use the "Depth of Field" menu to lighten or darken the edges of your picture, and the "Frame" menu, if you want to pick your own frame, rather than go with the "Use predefined frames" option. Click "Apply." Copies will be saved to the same folder as the originals, unless you've ticked "Overwrite old files."

GOING OLD-SCHOOL

1. SELECT PHOTOS
Click this button to discard the currently loaded images and choose a new photo, or set of photos.

2. PREVIEW WINDOW
Use this window to crop your image, plus preview the effects and image edits as you select them.

3. USE PREDEFINED FRAMES
Each preset comes with a recommended frame. Use it, rather than select your own, by ticking this box.

4. EDITING CONTROLS
Options for editing your photo are hidden behind five tabs: Effects, Crop, Rotate, Color Adjustment, and Resize.

5. TAB CONTROLS
This area displays different options (or instructions, when Crop tab is selected), depending on which tab you have selected.

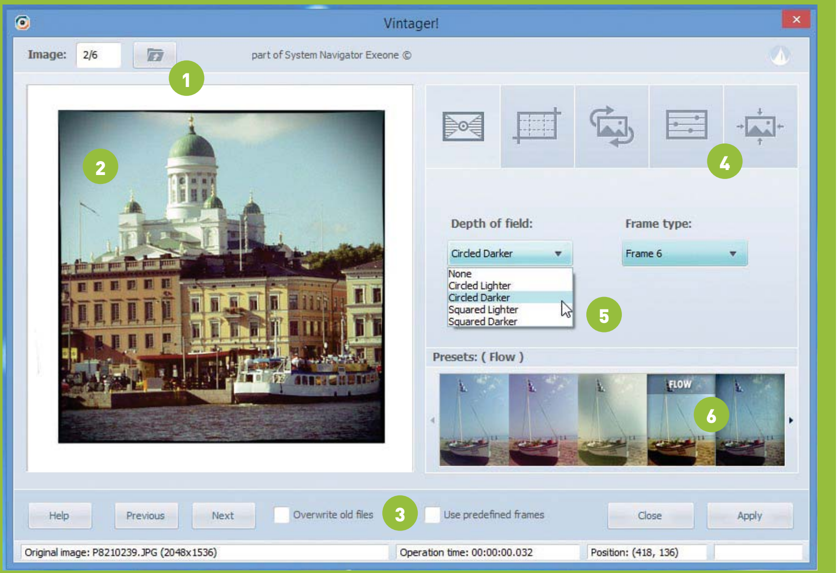


Image: 2/6

Depth of field: Circled Darker

Frame type: Frame 6

Presets: (Flow)

Original image: P8210239.JPG (2048x1536)

Operation time: 00:00:00.032

Position: (418, 136)

6. PRESET EFFECTS
Vintager has 17 different aging and coloring effects. Click one to apply it to the photo. Fine-tune until you're happy.

Stay Secure with Heimdal

YOU'LL NEED THIS

HEIMDAL SECURITY
Strengthen your PC's security with either the Free or Pro versions of Heimdal, found at http://bit.ly/1zMdODv.

THERE ARE STACKS OF ANTIVIRUS, anti-malware, and other security products on the market, and it's important to have one you trust installed and working at all times. Heimdal is a little different, though. It's a small, lightweight program that's designed to work together with your existing antivirus program, and continually monitors any third-party software installed on your PC that might be vulnerable to hacks.

Upgrade to the paid-for Pro version and Heimdal can do even more. It analyzes and blocks malicious links to keep you safe from phishing attempts, scans for and deletes malware, and checks all Internet traffic to ensure that sensitive data, such as passwords and credit card details, aren't being sent to known hacking servers. Let's see how both the free and Pro versions of Heimdal work. –**ED RICKETTS**

1 GETTING THE SOFTWARE

Heimdal Free is a tiny program, which you can get your hands on at https://heimdalsecurity.com. Just click the "Get It Now" link, then download the file, and run it. During setup, choose the option "I would like to use the free or currently registered version of Heimdal" to install the free version. We'll look at a way to try the Pro version later.

2 FIRST RUN

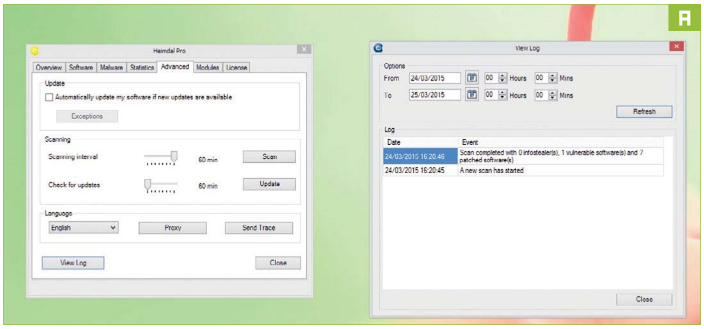
When Heimdal Free starts, it'll do a scan of your PC to look for known vulnerable programs—particularly plugins, such as Adobe Flash, which are constantly being updated. By default, it then automatically downloads updates for any that need it. Click the "Software" tab to see what's been done. There isn't much else you can do with the Free version, so let's go Pro….

3 GET A PRO TRIAL

Although the Heimdal Security website doesn't shout about it, there's a way to get a free month's trial of Heimdal Pro. Click the "Buy Heimdal" link. Change Country to "United States" and in the Voucher field, enter "heimdaldemo01." Click "Apply" and the price changes to "USD 0.00 for 1 month." Now enter your email and click "Continue to download."

4 ACTIVATE!

The next screen displays your activation code for the free month's trial. Copy and paste this, and keep it somewhere safe. You'll also see the date your trial expires. There's no need to download the software again, your activation key works with the free version you've installed. Just copy and paste your key in the "Go Pro" tab of the software to activate it.



Update
☐ Automatically update my software if new updates are available

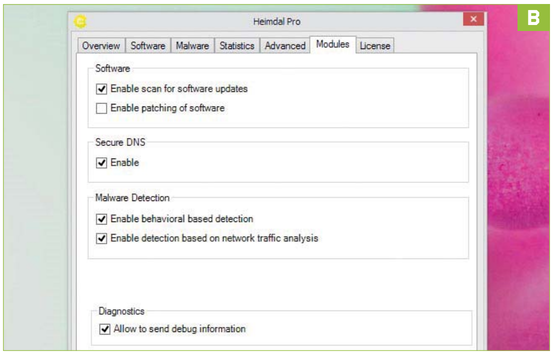
Scanning
Scanning interval: 60 min
Check for updates: 60 min

Language: English

Options
From: 24/03/2015 00 Hours 00 Mins
To: 25/03/2015 00 Hours 00 Mins

Log

Date	Event
24/03/2015 16:20:46	Scan completed with 0 infostealer(s), 1 vulnerable software(s) and 7 patched software(s)
24/03/2015 16:20:45	A new scan has started



Software
☑ Enable scan for software updates
☐ Enable patching of software

Secure DNS
☑ Enable

Malware Detection
☑ Enable behavioral based detection
☑ Enable detection based on network traffic analysis

Diagnostics
☑ Allow to send debug information

5 FINE-TUNING

You can go to the "Advanced" tab to customize Heimdal's operation. If you didn't want automatic download updates, but still want to know about any that are available, untick the box under "Update" [**Image A**]. You can change the frequency of scans for PC checks and software updates—the default 60 minutes seems excessive. "Proxy" and "Send Trace" are advanced options for special cases.

6 BADNESS BEGONE

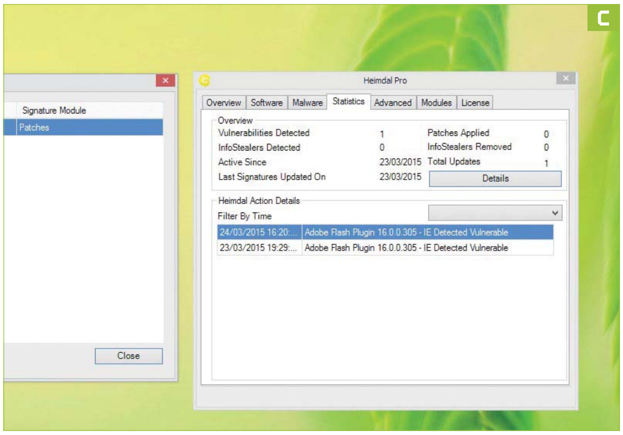
In the "Malware" tab, there should be very little to see. At least, we hope so! If Heimdal does detect any known malware or "info stealers" (programs that try to steal your personal details) on your PC, it will attempt to eradicate them and pop up a message to let you know. You can check out exactly what it's done in this section.

7 CUSTOMIZE AT WILL

In the "Modules" tab, you can turn off parts of Heimdal [**Image B**]. The "Software" section is similar to the options in "Advanced." Having "Secure DNS" enabled means Heimdal can check ingoing and outgoing traffic to ensure data isn't being sent to known phishing sites. "Malware Detection" lets it look for suspicious behavior on your PC, as well as unusual network activity.

8 WHAT'S GOING ON?

The "Statistics" tab shows you everything that Heimdal has done, including vulnerabilities detected, any software updates it has applied, and when it



Heimdal Pro

Signature Module
Patches

Overview

Vulnerabilities Detected	1	Patches Applied	0
InfoStealers Detected	0	InfoStealers Removed	0
Active Since	23/03/2015	Total Updates	1
Last Signatures Updated On	23/03/2015	Details	

Heimdal Action Details

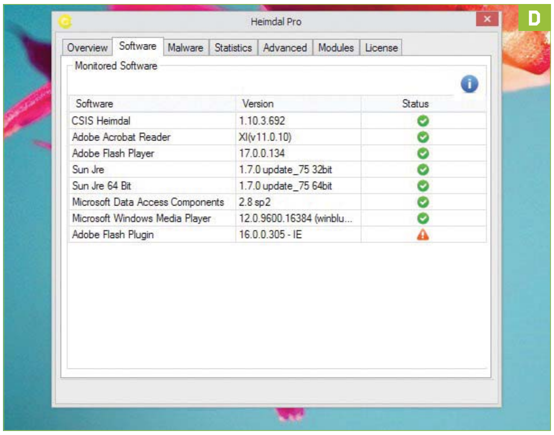
Filter By Time

24/03/2015 16:20:...	Adobe Flash Plugin 16.0.0.305 - IE Detected Vulnerable
23/03/2015 19:29:...	Adobe Flash Plugin 16.0.0.305 - IE Detected Vulnerable

last updated its own data or signatures. Click the "Details" button to see a full list of all updates Heimdal has applied to itself. Above [**Image C**], it detected a vulnerable Flash plugin twice, because we've turned off automatic updates.

9 ALERT, ALERT

Occasionally, Heimdal won't be available to automatically update certain programs itself, particularly more complicated ones, such as Flash browser players, which often need to be installed manually. In that case, you'll see the red "!" icon under "Software," indicating a failed update [**Image D**]. Try to update it yourself by going to the relevant site.



Heimdal Pro

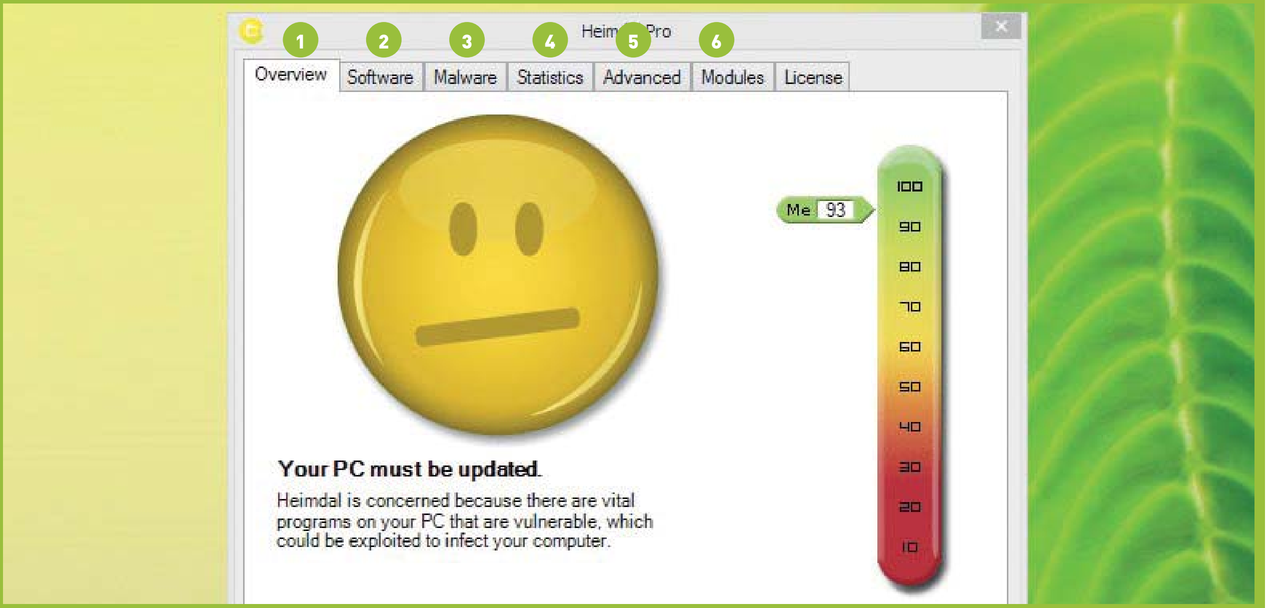
Monitored Software

Software	Version	Status
CSIS Heimdal	1.10.3.692	✓
Adobe Acrobat Reader	XI(v11.0.10)	✓
Adobe Flash Player	17.0.0.134	✓
Sun Jre	1.7.0 update_75 32bit	✓
Sun Jre 64 Bit	1.7.0 update_75 64bit	✓
Microsoft Data Access Components	2.8 sp2	✓
Microsoft Windows Media Player	12.0.9600.16384 (winblu...	✓
Adobe Flash Plugin	16.0.0.305 - IE	⚠

10 WANT MORE?

Finally, the 'License' section (only shown in the Pro version) displays your activation key, the date your license expires, and when the software last verified the license over the Internet. If you find Heimdal useful, you can always buy the full version after your month's trial expires. It costs $37 for a year. ⏻

MALWARE BEGONE



Your PC must be updated.

Heimdal is concerned because there are vital programs on your PC that are vulnerable, which could be exploited to infect your computer.

1. TURN IT OFF AND ON AGAIN
"Modules" enables you to turn on and off specific parts of Heimdal, for example malware detection.

2. TWEAK IT
In "Advanced," change parameters, such as how often Heimdal scans your PC, and whether to update software automatically.

3. KEEPING TABS
"Statistics" shows you everything Heimdal has done up until now, including updates applied.

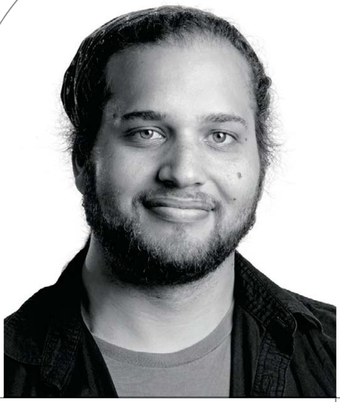
4. STOP THE ROT
The "Malware" tab is pretty simple. Most of the time (hopefully), it should be empty, indicating that no malware has been discovered.

5. KEEP IT CURRENT
The "Software" tab shows you which plugins are being monitored on your PC and whether they're up to date.

6. OVERVIEW
Gives you an at-a-glance look at the state of your PC's health according to Heimdal, complete with a percentage score for safety.

BUILD IT

ALEX CAMPBELL **ASSOCIATE EDITOR**



Little PC on the Prairie

An ultra-budget gaming PC for the shallowest of pockets

LENGTH OF TIME: **1–3 HOURS** LEVEL OF DIFFICULTY: **EASY**

THE MISSION

ONE LETTER came in from retired army sergeant first class Harley Roam, who wrote in from Texas. (Texas?! Only steers and... ahem... came from Texas. Right, Sergeant Cowboy?)

Harley expressed that he's not one with deep pockets. Our typical builds tend to be in the $800 range or more, but Harley was wondering if we could build a PC for $300 to $500.

Challenge accepted, we thought. Couldn't be all that hard, now, could it? So, we set out scouring the web for parts on behalf of Harley. We found out that you can indeed build a PC that's sluggish and cheap, but we don't want that for Harley. We wanted to make sure he could actually play games on his rig. We also wanted to build a system that would have room for upgrades that aren't too expensive. The build we ended up with was just shy of $600, so we came out close-ish to our goal.

We did the best we could to make sure Harley could build a good rig for as little scratch as we could bear. After all, we've all been in a spot where we weren't exactly flush with cash. So, pay attention, Harley, this build's for you!

RALLY THE TROOPS

SETTING A BUDGET OF $500 puts severe restrictions on our choices of hardware, and ultimately, we weren't able to make it. There are some things we just weren't willing to compromise, namely 1080p gaming with at least 30fps with settings cranked up. This led us to pick the GeForce GTX 960 for the GPU. We went with an Asus STRIX because we found it for about $200. While that's a big chunk of budget, it will give a solid gaming experience in many games you're likely to encounter. Going with team green also means you'll have a better experience in Linux gaming, should you choose to go with the free OS. After all, including Windows 8 in a build means saying bye-bye to a Benjamin. If you're building an ultra-budget machine, it's unlikely you have too many of them to spare.

For a processor, we went with an AMD FX-6300, which was $100. Between the GPU and CPU, we thought this would give Harvey a good base to build upon. We dropped the CPU and GPU onto a Gigabyte GA-970A-DS3P, which was about $60. We also dropped the idea of having an SSD or optical drive. The power supply is a little beefier than our needs called for, but we wanted to make sure the system could take an upgrade or two without hitting the upper limit of the PSU. The Enermax case we put everything into was surprisingly roomy for the build, and gave enough options for cable management and upgrades that meant we weren't left wanting.

INGREDIENTS

PART		PRICE
Case	Enermax Coenus	$60
Mobo	Gigabyte 970A-DS3P	$68
CPU	AMD FX-6300	$100
Memory	G.Skill Ripjaws 8GB 1866 DDR3	$65
GPU	Asus STRIX GTX 960	$200
PSU	Corsair CX500	$55
HDD	Seagate Barracuda 1TB HDD	$51
Total		$599

1

USING LESS TEXAS TEA

CORSAIR'S CX500 isn't as sexy as its modular siblings, but it gets the job done for a reasonable price. Normally, a non-modular power supply means a rat's nest of unused cables. We kept things tidy with the help of the case's beveled side panel behind the mobo. A few zip and twisty ties kept the unused power cables out of the way.

The CX500's meager (to us) output means it's small compared with the 1KW monsters you'll find in bigger systems. That's acceptable because our CPU and GPU aren't super demanding. The PSU is 80 Plus Bronze certified, which is a bare minimum when it comes to efficiency. If you do eventually upgrade to a bigger PSU, we prefer modular units to help keep things neat. Power cables are the largest cables in the case, and more of them makes maintaining good airflow and closing the right side panel a pain.

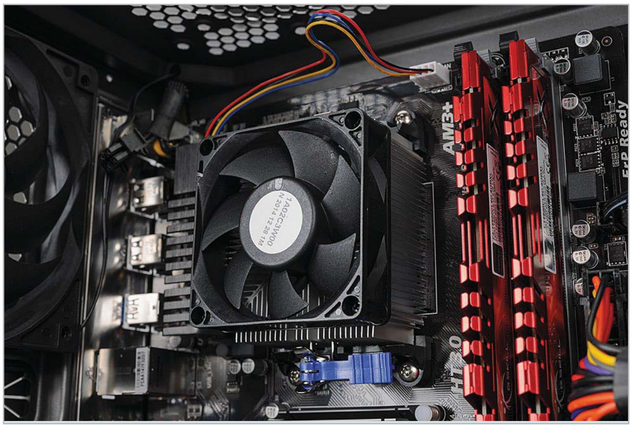
STRIX
PCI Express 2.0
On/Off Charge
CORSAIR
CX500

2

TAKE IT AT A MOSEY PACE

NOTHING FANCY to see here, folks—move along, move along. Our limited budget prohibited us from going crazy on cooling, so the stock heatsink and fan had to suffice. It wasn't so bad though; the FX-6300 stayed fairly cool with the stock parts. Even under load, it didn't feel like the processor was heating up the room. We didn't plan on overclocking the CPU, so excessive cooling wasn't warranted here. Using the stock heatsink and fan also saves you a bit of build time.

Of course, should you want to OC, we'd recommend grabbing an aftermarket cooler. For air cooling, Cooler Master's Hyper 212 Evo is only $35.

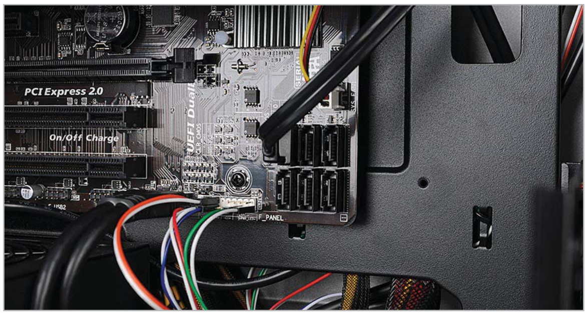


3

A SIMPLE KIND OF MOBO

GIGABYTE'S 970A-DS3P is a $65 motherboard that has all the basics you need. That said, our choice of mobo was a compromise due to our budget constraints. One thing we noticed about this particular board is that the right side didn't extend all the way to the forward column of brass standoffs. This meant that plugging in the ATX power connector was a little more hairy, as the board flexed a bit under the pressure. That was easily overcome by pushing the underside of the board with the other hand, though. Still, it was a bit of a gotcha you should keep in mind if you go with this board.

The motherboard is one of the parts that we consider "good enough for now," knowing that a user would probably want to upgrade it in the future. It's got all the basics, USB 3.0, and other standards like onboard FakeRAID. You can find good AMD 970 chipset boards for around $100, and 990 boards for a little more.

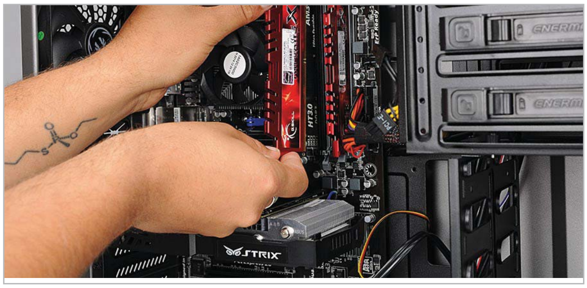


4

TAKE IT EASY

ONE GREAT THING about going with a stock heatsink and fan is that memory is a breeze to install. Click-click, bam! Done! For this build, we went with 1,866MHz G.Skill Ripjaws, which the motherboard took without need to overclock. We had to set the memory speed in the BIOS, but that's a relatively painless process. Eight gigabytes of memory is plenty for this build. Again, we weren't trying to go crazy. To stay within the ultra-budget range, we don't recommend going much higher in capacity or frequency.

The G.Skill Ripjaws aren't the cheapest DIMMs you can find, but they are relatively inexpensive, have decent timings, and will serve you well even if the CPU, motherboard, or other components are upgraded. While 1,600MHz memory is slightly cheaper, the 970 chipset and CPU support 1,866MHz without overclocking, so we figured: why not? If you have to squeeze every penny though, 1,600MHz memory is just dandy.



5

THE LONE HARD DRIVE

THIS IS A BUDGET BUILD, so we had to omit use of an SSD in favor of a single spinning drive. The 1TB Seagate Barracuda looks kind of lonely all by itself, but that also means the drive will have plenty of room to dissipate any heat.

Building systems with spinning hard drives as the system drive is a bit antiquated. Compared with SSDs, waiting on big file transfers feels like going back to the stone ages. Unfortunately—or fortunately, depending on how you look at it—prices for spinning hard drives don't scale at the same rate capacity does. Where a 500GB SSD might cost the same as two 250GB models, a 1TB HDD is usually less expensive than two 500GB units. That price difference precluded us from using RAID as a strategy to obtain higher transfer rates. For that reason, we recommend upgrading to an SSD as soon as there's spare money to burn.

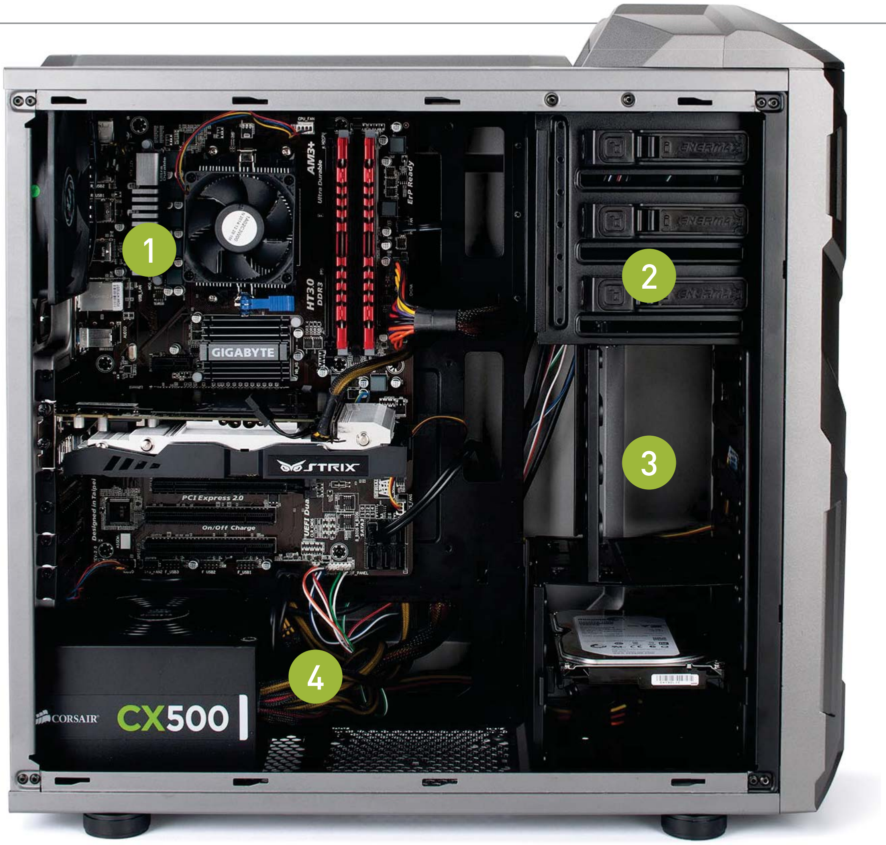
6

SEE THE SIGHTS

THE VIDEOCARD we chose is modest by many counts. Nevertheless, the GTX 960 can still produce playable frame rates at 1080p for a wide array of games. Don't think you'll be playing *Grand Theft Auto V* maxed out, but you can still get good-looking visuals for a pretty reasonable $200.

The Asus STRIX implementation of the GTX 960 is quite the compact card. The STRIX's size would pay off a lot more in a smaller, tighter system like an HTPC. But in the Enermax case, the card has plenty of room, making for a simple installation and power connection. The card is also inexpensive enough that buying another one down the road and using the two in SLI is a perfectly viable upgrade.

You'll have an easy time getting the card to work in Linux, as Nvidia's proprietary drivers are still the best performers on the open-source OS. So you'll be able to play *BioShock: Infinite* on Linux, should you go the way of the penguin.



1 It's rare that we leave a CPU with nothing more than a stock heatsink and fan, but we can get away with it since we're not overclocking.

2 The lack of an optical drive is not a crime. You can find Linux install media on USB drives, and if you need a DVD drive for Windows 8, they run about $20.

3 The 2.5-inch drive cage positioned above the 3.5-inch cage gives extra room for long graphics cards that otherwise wouldn't fit.

4 The CX500 isn't modular, so you have to stuff the extra cables somewhere. The case's beveled side panels make this easier for rookies.

WIDE-OPEN SPACES WITH ROOM TO GROW

LOW-BALLING ON PRICE isn't something we normally do here. We love our big $100 cases and $300 CPUs, but we get it that not everyone can afford to build in the $1,500 range.

At the same time, if we're going to compromise in the name of budget, there are some things we just aren't willing to skimp on. Even with a relatively modest $100 CPU, gaming relies heavily on GPU performance. Investing that $200 in a GPU will pay off in the long run, as other components are upgraded.

Building PCs is more than just performance, it's a hobby and passion for us. If money is tight, it's sometimes better to get a modest base and improve it all the time. That will make a story out of the continual work. Just as a project car can go from rust-bucket to show material, a computer can go from a budget build to a face-melting machine that bends space-time given enough time, blood, sweat, tears, and disposable income.

We wanted to create a solid base to build on. The case offers plenty of opportunities for expansion, and the GPU and CPU combo will get the system started in the right direction. While the build drags its ass for a number of reasons—namely, the modest CPU and a spinning hard drive for the OS—the six cores of the FX-6300 combine to get work done in multithreaded applications. Also, you should be able to play quite a few games at 1080p at modest settings with the GTX 960.

Transforming this build from modest to mighty can take any number of approaches with incremental improvements. An SSD will level-up your data-transfer speeds significantly, and is the best way to enhance the build. The boost in storage speed should be followed by a more robust motherboard with features like M.2 support. A mobo upgrade will present the choice to stay with the AM3+ socket or to switch over to an Intel board.

If you choose to stay with AM3+ and go with a better AMD CPU or overclock the FX-6300, investing in a closed-loop water cooler is ideal. Packing in more case fans will make life easier for overclockers, as well. With this case, there's plenty of room for a small cooler and extra fans. Going with Intel will cost you some extra coin, but will allow for a less aggressive cooling solution.

We enjoyed this challenge, even if we couldn't quite get it down to $500. Sorry about that, Harley, but we wanted to make sure you'd have a better base machine for gaming and video. Prices do fluctuate, and we saw a few rebates that brought the build down by $40–$50. By the time you read this, maybe you'll be lucky enough to take advantage of a couple of deals and get started. Happy trails! ⏻

BENCHMARKS

	ZERO-POINT	
Premiere Pro CS6 (sec)	2,000	2,194 (-9.7%)
Stitch.Efx 2.0 (sec)	831	1,685 (-102.8%)
ProShow Producer 5.0 (sec)	1,446	1,717 (-18.7%)
x264 HD 5.0 (fps)	21.1	9.9 (-53.1%)
Batman: Arkham City (fps)	76	39 (-48.7%)
3DMark 11 Extreme	5,847	3,294 (-43.7%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% 110%

Our current zero-point consists of a hexa-core 3.2GHz Core i7-3930K (turbo 3.8GHz), 16GB of Corsair DDR3/1600, on an Asus Sabertooth X79 motherboard. We are running a GeForce GTX 690, an OCZ Vertex 3 SSD, and 64-bit Windows 7 Professional.

AMD
PRESENTS

PC GAMING SHOW

POWERED BY PC GAMER

Tuesday, June 16th | 5pm - 8pm

IT'S HAPPENING

Now, for the first time, the PC platform will have its own event during E3, where the community will be able to celebrate this era with some of the biggest names in PC gaming and see the innovations that lie ahead.

Hosted by Sean 'Day[9]' Plott, the PC Gaming Show will take place at the Belasco Theater in Los Angeles on Tuesday, June 16, 2015.

In partnership with Twitch, the PC Gaming Show will be streamed live, and feature new game reveals, updates on beloved series, and perspectives from key PC developers.

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www.pcgamingshow.com

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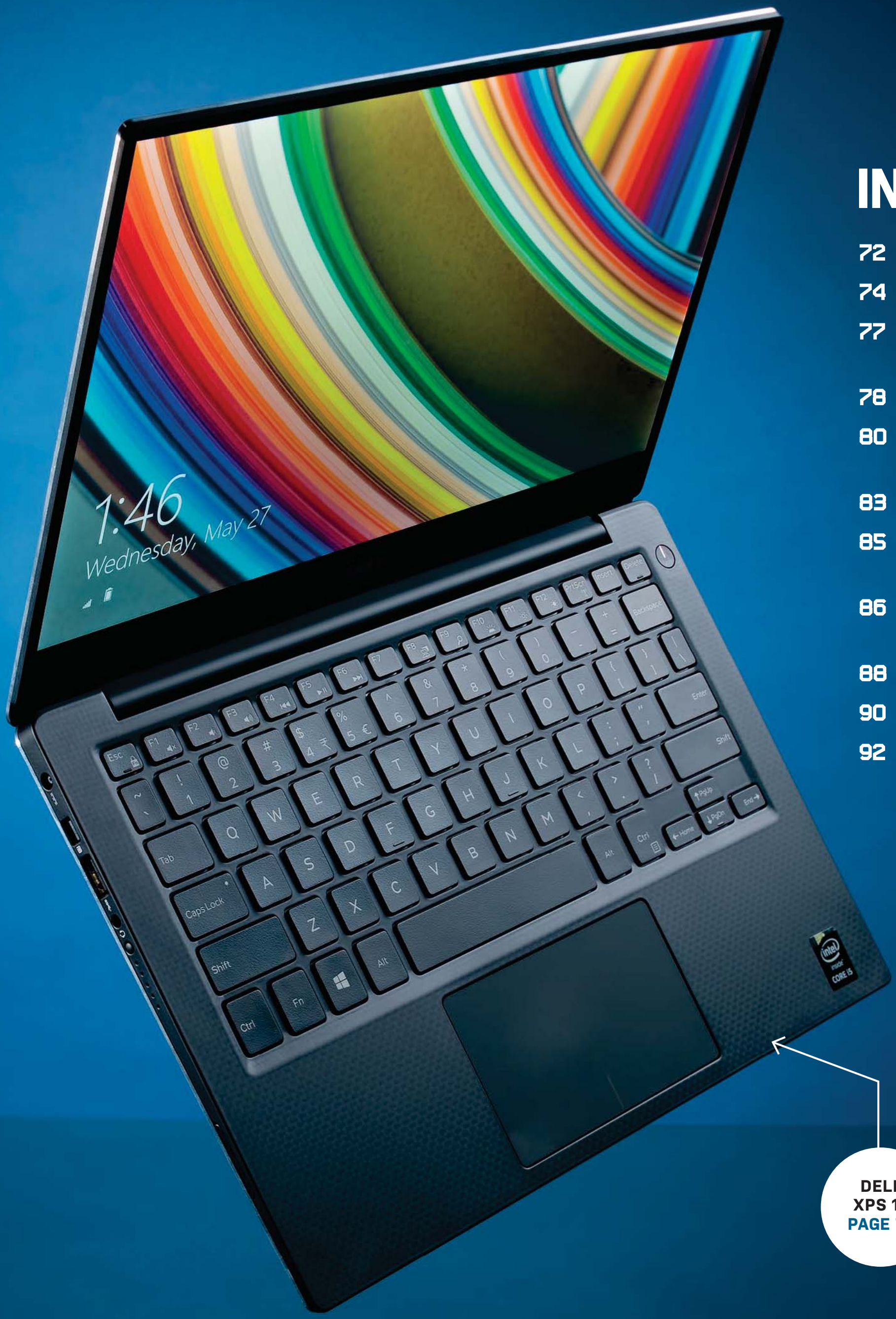

INSIDE

72 Dell XPS 13

74 Viewsonic VP2780-4K

77 Thrustmaster Leather 28 GT

78 Raijintek Triton AIO

80 Audio-Technica ATH-PDG1

83 Turtle Beach Grip 500

85 Turtle Beach Impact 500

86 The Witcher 3: Wild Hunt

88 Project Cars

90 Kerbal Space Program

92 Lab Notes

DELL
XPS 13
PAGE 72

Unlike Apple's new MacBook, it actually has ports!

Dell XPS 13

The new standard for Ultrabooks

DELL'S XPS 13 line of laptops has been around for years now, and while its 2015 model doesn't try to reinvent the wheel, Dell has made enough improvements to feel justified in claiming it has the best Ultrabook on the market. We'll see...

The compact chassis gives the XPS some sex appeal. Measuring 11.9 x 8 x 0.5 inches and weighing just two pounds, 12.4 ounces, it's extremely portable. While a chassis this small usually sports an 11-inch panel, Dell impressed us by squeezing in a 13.3-inch 10-point touch display. This is done through what Dell calls its "Infinity Edge" display. That's marketing jargon for thin, flush bezels that measure 5.2mm across.

While the panel isn't huge, the resolution is enormous at 3200x1800. Certain Windows programs might look small but, surprisingly, it looks fine for most applications. Some users may also be put off by the glossy panel, but the viewing angles on this IPS display and the vibrant colors it offers are undeniably fantastic.

The body shape puts it in the MacBook Air category, and while it even sports a downward slope that's similar to the Apple, it's got its own thing going aesthetically. Composed mainly of machined aluminum, the XPS has a carbon fiber palm rest. It's mostly black, with the exception of its silver back, where you'll also find the Dell logo etched in. It would be nice if the logo had a lighting option (all the cool kids are doing it), but maybe Dell designers thought it best to go minimal. Luckily, it does have a backlit keyboard, which is more important.

The laptop is small, so some people may be unimpressed by the compact keyboard, but it didn't bother us. We weren't too crazy about the trackpad, however, which offers a little unwanted acceleration. The notebook's speakers have a surprising amount of firepower, but we're a little let down that they're side-firing, as opposed to front-facing. In terms of ports, you've got your charging port, two USB 3.0 ports, mini DisplayPort, headphone jack, and SD card slot. We wish it offered Mini-HDMI, but it's got all the bare essentials, and offers more ports than other leading notebooks (ahem, Apple, we're looking at you).

When it came to performance, our XPS 13 and its 2.2GHz Core i5-5200U processor didn't blow our socks off. It performed better than our Acer S7's Ivy Bridge in our Stitch CPU benchmark, by 8 percent, but lagged by 3 percent in our multithread-heavy x264 test. It's worth noting this isn't an apples-to-apples comparison, however. Our ZP uses a Core i7-3517U processor with a max turbo frequency of 3GHz, which trumps the Core i5's 2.7GHz top speed. Also, when our S7 zero-point goes full blast, it's almost leaf-blower loud. The XPS 13, meanwhile, plays it cool and quiet.

ULTRA, NOT GAMER

In graphics territory, Dell gave our zero-point a thorough thrashing. Intel has been making noticeable improvements when it comes to integrated graphics; the fruit of its labors means a performance delta between 40–70 percent here. If you're thinking this means you'll be able to do some hardcore gaming on this thing, however, you'll want to think again.

Even with everything turned low, we got unplayable frame rates (mid-20s) running *Tomb Raider* at 1080p. This proves that gaming laptops aren't getting pushed off the table by lighter fare anytime soon.

There were a few other areas where the laptop failed to impress, battery life being chief among them. In our video-rundown test, the XPS 13 lasted 223 minutes, which is fine for even the lengthiest of Peter Jackson movie edits, but if you're hoping for something that will last an entire workday, this model isn't for you. Dell says its 1080p configuration will last longer, since the laptop doesn't have to push as many pixels, but as we don't have that unit to test, we can't validate the claim.

Another gripe is that the camera is located on the lower left-hand corner of the monitor, as opposed to the usual top-middle. This validates the old saying that the camera adds 15 pounds, at least that's the excuse we're going with. Finally, the laptop does get a little warm underneath, but it won't singe your lap.

These knocks against the XPS 13 prevent us from awarding it a Kick Ass score, but quibbles aside, it's a great Ultrabook. Its 12.9-second boot time is among the fastest we've seen, and the laptop is sleek, incredibly portable, and priced fairly. It's not perfect, but it may be the best Ultrabook out there at the moment. **–JIMMY THANG**

VERDICT
9

Dell XPS 13

+ 13 GOING ON 30 Beautiful, sharp screen; ultra-portable; super quiet.

– 30 GOING ON 13 Mediocre battery life; not super powerful.

$1,400, www.dell.com

BENCHMARKS

	ZERO-POINT	DELL XPS 13
Stitch.Efx 2.0 (sec)	1,851	1,710 (8.2%)
Proshow Producer 5 (sec)	2,387	2,392 (-0.2%)
X264 HD 5.0	5.4	5.2 (-3.7%)
Tomb Raider (fps)	17.4	24.9 (43.1%)
3DMark 11 Perf	645	1,094 (69.6%)
Battery Life (min)	221	223 (0.9%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero-point is an Acer S7 with a Core i7-3517U processor that has a max turbo frequency of 3GHz.

SPECIFICATIONS

CPU	2.2GHz i5-5200U
RAM	8GB DDR3
Display	13.3-inch 3200x1800 IPS LCD
Storage	256GB SSD
Connectivity	2x USB 3.0, Mini DisplayPort, SD card slot, headphone
Lap/Carry	2lb, 12.4oz 3lb, 5.3oz

Viewsonic VP2780-4K

IPS plus 4K? Sounds like a good start…

ONE DAY, everything will be 4K. Well, until everything's 8K. Or 16K. Or whatever. Actually, there will be a point at which further pixels are pointless. Once you've matched the visual acuity of the human eye, once pixels are too small to be individually detected. Well, that's the end game.

It's why Apple coined the term "Retina" display to describe the ultra-high pixel density offered by the screens in some of its portable devices. We're not quite there yet with PC monitors, even with 4K. But the broader topic of perceived sharpness is highly relevant for 4K, and throws up an important question. What matters most to you? Image quality or usability? Because right now, you can't quite have both.

Allow us to explain. In the context of PC monitors, 4K means something simple, namely 3840x2160 pixels. The critical point is that you get all those pixels regardless of screen proportion. With 4K monitors available in sizes ranging from 24 through to fully 40 inches, that makes for a huge spectrum in terms of pixel pitch or density.

The new Viewsonic VP2780-4K enters that fray at a middling 27 inches. The upside is that it looks super-sharp. If you thought a 27-inch panel at 1440p (2560x1440 pixels) looked crisp, 4K on the same panel size will absolutely blow your mind. Or make your eyes bleed. It's glorious. And yet, not without pitfalls.

For starters, everything is tiny with Windows running at its default settings. Too tiny for comfort, in our view, even with good-going-on-perfect eyesight. If your peepers come up even slightly short, then absolutely forget about it. So tweaking the DPI setting to make everything a bit bigger is likely essential. But that throws up its own problems.

KEEPING IT TIGHT

Regardless of Microsoft's protestations, Windows still looks broken when you move away from default DPI. That's partly down to crapness on behalf of MS. Even core elements of Windows can be unbalanced by non-default DPI. Then there are all the third-party apps and software that haven't been optimized for multiple DPI settings. And, of course, most of the Internet.

People tend to forget about the latter, but very few websites are properly coded for multiple DPIs. It doesn't matter so much on a small portable screen. But on a big PC monitor, those stretched bitmaps and jpegs can look terrible and clash with the super-crisp fonts. It's also worth remembering that bumping up the DPI setting makes for less usable desktop real estate, which is surely one of the core propositions of 4K.

Put it all together and we still think 4K makes far more sense on panels well over 30 inches, where running default DPI settings can be done with reasonable comfort. The other generic 4K conundrum involves gaming, or more specifically the problem of pumping all those pixels to the panel in a timely fashion. Essentially, 4K involves a scarcely comprehensible 8 million pixels, all of which have to be pushed through the graphics pipeline with all the advanced 3D processing that now entails. It's hard to get your head around achieving that *once* in a second, much less the absolute bare minimum of 30 times that gaming requires. PC graphics are truly a wonder of the modern age.

DECISIONS, DECISIONS

Anyway, 4K gaming is possible, but only just. And that's when using $1,000-worth or more of graphics card or cards. As it happens, thanks to that tight pixel pitch, interpolated resolutions like 1440p look pretty good on the Viewsonic. Running non-native in-game isn't the disaster it's been historically. In theory, you could make do with 1440p until truly 4K-capable graphics cards become affordable. That's your call.

You'll also have to decide whether features like high refresh rates of 120Hz and more, or adaptive-refresh tech are deal breakers for you, because inevitably, the 4K panel doesn't have them. There's no getting away from it. Even on the desktop, 60Hz screens suffer from noticeable judder compared to the high-refresh brigade.

So, thanks to the recent explosion in monitor innovation, finding a model that packs all the features you want is tricky, going on impossible. Want 4K, plus 120Hz, plus frame syncing? Yes please. But it simply isn't available, never mind that the notion of pumping 8 million 3D-rendered pixels at 120Hz seems quite preposterous, even if it no doubt will be possible within five years or so.

Still, if the 4K aspect of the VP2780-4K is problematic, specifically at 27 inches, in a broader sense, we've little quarrel with the panel's quality. It's an IPS panel and when you fire it up for the first time, it looks absolutely, positively spectacular at factory defaults. That's no doubt aided by a proper pre-delivery calibration complete with a print out showing the various deltas, if you care about such things.

You will care about the super-clean whites and impeccable color balance. It's so rich and vibrant while also being natural and not over-saturated. It's a tricky balance to strike and this Viewsonic absolutely nails it. For the record, it demolishes our objective image tests, turning in perfect white and black scales, immaculate gradients, and super viewing angles. Oh, and the anti-glare coating is smooth and entirely free from the horrific sparkle that used to marr IPS.

The VP2780-4K is nice as a thing, too. Styling-wise, it's in the traditional Viewsonic VP mould, which is a definite plus point. Understated, but with an air of quality, to which you can add a sturdy and fully adjustable stand. Our objections then are philosophical rather than to do with execution. In other words, if you're in the market for a 27-inch IPS 4K screen running at 60Hz, this Viewsonic is great. But unless you're a graphics or imaging pro, or up to something with similar niche high-DPI requirements, we're just not sure you should be. **–JEREMY LAIRD**

VERDICT 7

Viewsonic VP2780-4K

+ BEAUTIFUL VISTA Stunning IPS-plus-4K image quality; all those pixels; nice chassis and stand.

− WINDOWS VISTA Super-fine pixel pitch can be a problem; no high refresh or frame syncing; not exactly cheap.

$821, www.viewsonic.com

SPECIFICATIONS

Panel Size	27-inch
Native Resolution	3840x2160
Panel Technology	IPS
Refresh Rate	60Hz
Pixel Response	5ms
Inputs	MHL x2, DisplayPort, Mini DisplayPort
Stand	Fully adjustable with VESA 100mm

A familiar VP-style
Viewsonic chassis houses
cutting-edge 4K tech.

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Thrustmaster Leather 28 GT Wheel Add-On

Hand-stitched leather hasn't looked this good since *Desperate Housewives*

ATTRACTING A MEMBER of the opposite sex into your bedroom can be a tricky business, so the last thing you need is having certain unappealing items left lying around to potentially dampen the mood. Posters of scantily clad celebrities don't tend to go down well, while the sight of a fake steering wheel clamped in front of your monitor could be seduction suicide.

Fear not though, as this wheel may as well be an aphrodisiac, exuding quality from its hand-stitched leather and 2mm-thick brushed-metal center panel. Six buttons and a D-pad provide plenty of control, plus there's a manettino dial for a taster of what life would be like behind the wheel of a Ferrari 458. Thrustmaster's dial is more show than go though, with an air of a budget 1990s stereo, rather than Maranello's finest.

Otherwise, you'll be hard-pressed to find any quality flaws. Despite weighing just 1kg, the wheel is fitted with substantial 13cm-long metal paddle shifters, so there's no excuse for missing a gear shift when you need to unleash your inner Dominic Toretto for a fast getaway. The buttons are rated to withstand over 10 million hits, and the 28cm-diameter wheel gets an inner steel hoop for strength and better force feedback transmission.

Trouble is, you can't just fling this wheel about in mid-air and expect things to happen. You'll need a T300, T500, or TX-series racing system to use it with, and since these already include a wheel, you're going to end up with a pair of wheels for the single force feedback unit and pedal set. That's bad feng shui, and your bank balance isn't going to be happy either, with compatible setups starting at around $300.

At least you'll be able to attach and remove your leather-bound beauty in no time, courtesy of Thrustmaster's Quick Release system, right? Well, if this is the designer's idea of a quick release, their partner must have a serious problem with RSI. Rather than a simple locking clip mechanism, such as you might find attaching an F1 car's steering wheel, here you'll need to tighten a large plastic nut instead. No big deal, if only the nut didn't nestle in the annoyingly tight gap between the back of the wheel and the motor unit.

HELL FOR LEATHER

But once everything is ready and you can put pedal to metal (well, plastic), it all comes good. Whichever racing system you mount the Leather 28 GT to, TM's excellent force feedback motor brings it to life. There's a colossal 1,080-degree max rotation, plus dual belt drive for near-silent force feedback, and contactless magnetic position sensing for max rotation accuracy and increased longevity. The result is superbly strong and communicative feedback, with none of the usual gear grinding that lesser wheels can produce.

Such advanced internals do need to be kept cool by means of a fan, and unfortunately this is far from silent. It's certainly not going to overshadow your racing, but it's loud enough to partly undo all the effort that went into making the motor drive so smooth and quiet.

Of course, the TM Leather 28 GT isn't to blame there, but it's not off the hook. This is undoubtedly a great wheel, but it's also essentially the same as what's included with Thrustmaster's T300 Ferrari GTE setup, only you get to grip leather rather than rubber. If you could spec your own motor/wheel/pedal combo, then it'd make sense, but splashing this much cash to get a second wheel purely for a different texture hardly seems like the best route to driving nirvana. **–BEN ANDREWS**

VERDICT
7

TM Leather 28 GT Wheel Add-On

+ **WHEELY HOT** Top quality materials and build; plenty of controls; multi-system compatibility.

− **WHEELY NOT** Only worth it if you've got a leather fetish; quick release system is anything but.

$150, www.thrustmaster.com

SPECIFICATIONS

Diameter	28cm
Weight	1kg
Requires	T300 RS/T300 Ferrari GTE; T500 RS/Ferrari F1 Wheel Integral T500; TX Racing Wheel Ferrari 458 Italia Edition

Raijintek Triton AIO

Hard to pronounce, easy to install

ANOTHER DAY, another company you may not have heard of before. Only established in 2013, Raijintek is yet another marriage between German designers and Taiwanese manufacturers, producing a range of fans, cases, and coolers. One of its latest products is its first liquid cooler, the Triton All-In-One.

The first thing you'll notice, releasing the Triton from its box, is the quality of the components. They're not quite up to the same standard as other AIOs we've looked at lately, such as Corsair's Hydro H110i. But a glance at the Triton's price tag might explain why—it's significantly cheaper.

The pump unit is a beast, quite a bit taller than the one on the Corsair Hydro H110i, for example, and runs almost silently. The unit is made from clear acrylic with a chrome-plated copper base, and uses a graphite pipe and ceramic axis bearing. It runs at 3,000rpm and can shift 120l/hr. For those who like things to be lit up, the pump unit is illuminated by a pair of white LEDs. As part of the extras, you get three dyes—red, green, and blue—to color the coolant, if transparent liquid just isn't your thing.

GETTING KINKY

After dealing with some impressive manuals that came with the last few liquid coolers we've reviewed, it was a shock to see the basic fitting instructions Raijintek supplies. But truth be told, the design has been so well thought-out that more detailed instructions simply aren't needed. Having said that, first-timers might find a bit more hand-holding reassuring.

One thing to take care of is the hoses. These don't have anti-kink coils fitted, so care must be taken not to flatten them. What they do have, however, is standard compression fittings, meaning the cooling loop can be customized with off-the-shelf components. So, although it's marketed as an All-In-One, it can be expanded, by adding in a GPU water block, for example.

The Triton comes with a pair of 120mm fans (rated between 1,000 and 2,600rpm), but surprisingly these aren't PWM fans. Instead, they're controlled by a rheostat, which means having to get your hands inside the case to turn the fans up or down as required. It's a pain. If you want to use the Triton for an overclocked system that doesn't scream the house down, and have a preference for cooling fans you can monitor, it's worth tracking down the cheaper Core Edition version, which comes without fans.

At the Core i7-4770K's stock speeds, the Triton performs remarkably well, keeping the processor at 21°C, and with hardly a sound. Without any PWM fans, it's down to you to adjust the rheostat to get the right balance of performance and noise, which is a job you could do without. To test at standard clock speeds, we adjusted the rheostat to around the middle position to get the best balance. At stock speeds with a 100 percent load, the cooler still performs pretty well at 62°C, though it does trail behind the much more expensive Fractal Design Kelvin S24.

For overclocking performance, we took no chances. Turning the fans up to full speed and at full load, the Triton once again fell behind the Kelvin S24, but still kept the processor at under 90°C. However, with two 2,600rpm fans running at full chat, the only way to describe it is *LOUD*. The Triton performs much better than its price tag implies. Even so, by not having PWM fans, Raijintek isn't doing itself any favors. –**SIMON CRISP**

VERDICT 7

Raijintek Triton

TITAN Good value; funky coolant dyes; straightforward to fit; expandability.

RAIN CHECK Hoses kink quite easily; fitting instructions could be better for less experienced users; non-PWM fans.

$100, www.raijintek.com

BENCHMARKS

	Raijintek Triton	Fractal Design Kelvin S24
Reference CPU 100% Load (°C)	62	**49**
Reference Peak-to-Idle (sec)	197	**166**
Overclocked CPU 100% Load (°C)	85	**76**
Overclocked Peak-to-Idle (sec)	209	**182**

Best scores are bolded.

SPECIFICATIONS

Socket Support	Intel and AMD
Water Block	Nickle-plated copper cold plate
Fans	2x 120mm (1,000 - 2,600rpm)
Radiator Dimensions (W x H x D)	275 x 120 x 32mm
Warranty	Two years

RAIJINTEK CORPORATION

The Triton performs well for its price, but needs a better choice of fans.

Audio-Technica ATH-PDG1

Gaming cans from the big boys of studio sound

STEP INTO ANY recording studio and you'll see a raft of Audio-Technica kit. Indeed, the Japanese firm is beyond proving itself in the pro audio sector. But it's a different story in the PC enthusiast market. After an uncertain first outing in the form of its ATH-AG1 gaming headset, A-T's still in away-game territory when it comes to gamers.

That first-gen gaming headset had two major drawbacks: It was unreasonably expensive and it favored a paddle support system instead of the more comfortable headband. Everything else was pretty much on point. As you'd expect from such a prestigious brand, sound quality was precise, refused to distort at high volumes, and featured an impressive stereo spread range. That's an important preface to the arrival of these cans; a second generation of gaming audio priced below its predecessor, and featuring a traditional headband design.

The PDG1 has a new sibling in A-T's second-gen gaming headset range, the ATH-PG1, the latter offering a closed-cup design in contrast to this model's "open air" dynamic drivers. What's the difference? There's no clear superior, both having their pros and cons. Open-back headphones let in more external noise and leak more of your audio out into the room, which means they're not as good at producing powerful low-end than closed-back cups. However, they're generally better at creating a wider soundstage, giving the impression that the audio's coming from all around you. Closed-back cans tend to sound like the audio's coming from inside your head.

We generally prefer closed-back headsets. However, the ATH-PDG1 makes a very convincing case for itself. Stereo spread is, indeed, very impressive. We're not talking about digital surround—these cans are getting no help from a soundcard or firmware layer to create cinematic Dolby whizzbangery. It's all about how those 40mm drivers behave organically based on their engineering. As such, they're capable of mighty impressive clarity and spread, easily equal to the first-gen ATH-AG1 in all aspects other than low-end oomph.

THRILLS, NOT FRILLS

They're *much* more comfortable, too. At 225g, these are legit featherweight headphones that bear no disconcerting squeaks or creaks when adjusted to fit. You can even flip each earcup to face outward, DJ style, which proves useless in a gaming setting, but serves as a reminder of A-T's prevalence beyond the gaming sector.

We wouldn't call the cushioning on the headband generous, but it doesn't need to be when the unit's so light. The only potential for discomfort is in the short distance between the padded contact point and the speaker surface of each earcup; leading to your ear pressing against the hard, flat speaker surface a little. We didn't find this enough of an issue to force us to take a breather, though.

Lessons have clearly been learned in the field of ergonomics, then. But pricing remains slightly problematic. These new cans are positioned at $200. And for that price, this is something of a no-frills package. No carry case, no swappable contact pads, no braided cable. The inline remote's distinctly economy class, offering a slightly apologetic mic mute on/off switch and volume scroller. There *is* a smartphone cable, but that's literally all she wrote when it comes to added extras.

That creates a dilemma. The ATH-PDG1 does do the fundamentals exceptionally well. Even the mic's worthy of mention for its adjustability and clarity. We've berated plenty of pricey headsets for their inclusion of meaningless distractions like customizable LEDs, so it's great to see a product focusing on doing the important things well. However, it doesn't do those things demonstrably *better* than other models—step forward Kingston's HyperX Cloud and Cloud II. Nevertheless, it's an encouraging step for A-T, placing its gaming products among the ranks of the best, just not quite at the apex. **–PHIL IWANIUK**

VERDICT
8

Audio-Technica ATH-PDG1

+ **SPACIOUS** Open-back design is rare, but the soundstage on offer here makes a good case for a revival.

− **FISCALLY VORACIOUS** We're all for performance over frills, but the construction materials and presentation don't convey $200.

$200, audio-technica.com

SPECIFICATIONS

Driver Size	40mm
Frequency Response	20Hz - 20KHz
Weight	225g
Cable Length	3.2m
Connection Type	Single mini stereo jack plug (3.5mm)
Mic	Omnidirectional condenser

ATH-PDG1
LEFT
LEFT

The high price point isn't conveyed aesthetically.

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The soft-touch coating is more grip fail than Grip 500, but it would be lovely inside socks.

Turtle Beach Grip 500

Like a kitten in your hand, but no pussycat when you get gaming

TURTLE BEACH is really onto something with the soft coating it's dipped the Grip 500 in. Its molecules spun and woven to feel like the firmest marshmallow beneath the hand, the mouse kisses your fingertips like a nymph newly spawned from a pool of inky black water, begging for protection from a pursuing satyr.

Other things we'd like to see dipped in this stuff include the door handles on lingerie shops, those massive KFC containers you should never try and finish on your own, and most glorious of all, the insides of our socks, so we could wiggle our toes against it all day and get a little shiver of excitement each time.

Back to the mouse. You get seven buttons, all programmable with commands or macro sequences but not really suitable for left-handers. You could probably get away with using it in the left hand at a pinch, but the position of the buttons that fall so nicely under the right thumb would lead to some awkward ring-finger gymnastics, were you to try it for long gaming sessions. You can click the main buttons all the way back at the mouse's mid-point, useful should you have particularly short fingers.

The body of the mouse is broad, sitting high in the palm for those who prefer it that way, while a tapered shape accommodates claw grippers. It fits perfectly in our giant-sized hands, but could be too big if you're somewhat more lightly built. Button layout is nicely thought-out, as long as you're prepared to use your thumb, with a good amount of travel once you've pressed down. It never feels like you're going to push the switch all the way through the body of the mouse, which is comforting.

The main switches are Omrons, the ubiquitous choice of the gaming mouse, and the infrared garnet eye of an Avago laser sensor gleams invisibly underneath. There are the now-traditional grilles either side of the cable to make the mouse look like a sports car, and the lighting can be adjusted with an app, which also handles the button programming. Five color-coded profiles can be copied to the mouse's onboard memory, ready to be switched between on the fly, if you can remember which is which and can be bothered to set them up.

TOO SOFT?

The wheel, where so many mice fall down, is nicely notched and sports a grippy tyre. It feels very light, however, putting up just barely enough resistance to being spun. We'd have liked to see a bit more presence and weight to it, so we could be certain we'd rotated it rather than just brushed against it. It can be assigned different functions using the PC app, which is nice to see, though we lack the imagination to think of too many situations in which it would actually be useful.

The soft-touch coating could, sadly, prove to be the Grip 500's major drawback. If you regularly game in a sauna, or perhaps one of the hotter parts of the country, you may build up a tiny bit of perspiration. Should this happen, the mouse is going to get quite slippery, the problem being that there are no ridges to hold your fingers on the buttons or grippy textures on the body. This is especially true on the left of the body where your thumb rests. Come down from the buttons too hard and you risk sliding off and thumbplanting the desk underneath, possibly causing a nasty bruise.

There's also the price. For about $15 less, you could get yourself a Razer DeathAdder or Logitech G502, either of which is more satisfying to use than this otherwise commendable, comfortable effort from Turtle Beach. **–IAN EVENDEN**

VERDICT
6

Turtle Beach Grip 500

➕ **GRIPPER** Lovely soft finish; decent buttons; customizable.

➖ **KIPPER** Can be slippery; lots of competition at this price point.

$70, www.turtlebeach.com

SPECIFICATIONS

Sensor	Laser
Max Sensitivity	9,800dpi
Programmable Buttons	Seven
Cord Length	2m
Connector	USB

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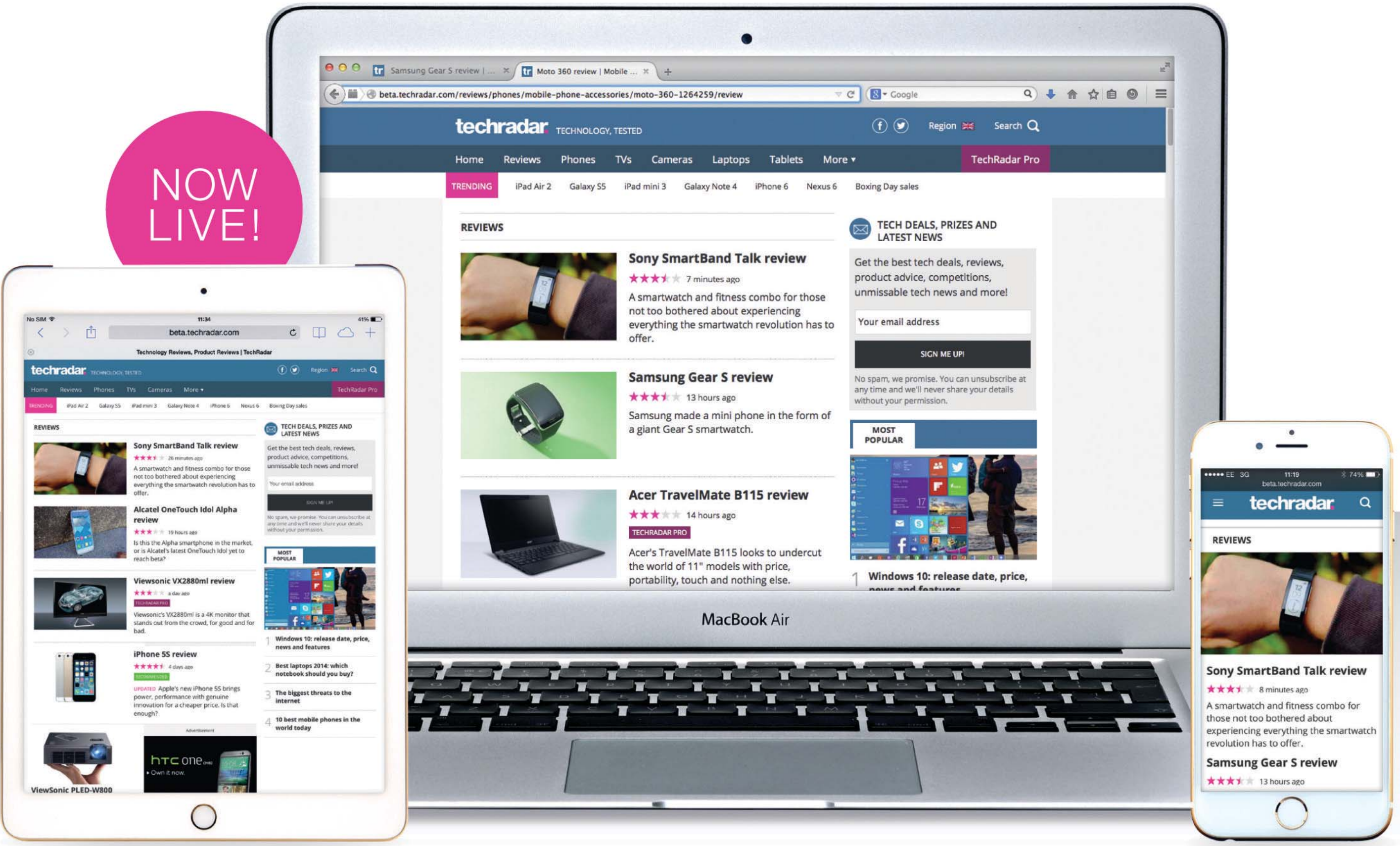
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TURTLE BEACH
IMPACT 500

Turtle Beach Impact 500

The Tyrion Lannister of the mechanical keyboard world. Only without the wenches. Or wine. Or wit

TURTLE BEACH is perhaps better known for the gaming headsets it's been making for many years, but it's increasing its holdings in the peripherals market with a range of keyboards and associated pointing devices. They've all got something in common: They're as black as a panther at midnight and are sturdily built, with the kinds of features you'd expect to see from more established desktop manufacturers, such as Logitech.

The Impact 500 is a mechanical keyboard with the number pad amputated, a kind of keyboard carbine for the sort of close-quarters typing that means waiting until you see the whites of your enemies' eyes before you unleash a barrage of trash talk. There's even a removable mini-USB cable (that's nicely braided), so you can make a swift escape from a player more skilled at insults than you. Lol.

The soft coating we waxed lyrical about on the Grip 500 mouse (see page 83) is present, and makes a bit more sense on a keyboard. It's still gorgeous, but the keys here are smooth-topped rather than rubber-coated, and feature the kind of contouring that the mouse was so sorely lacking. Even the sweatiest finger will have a hard time falling off, and there are deep gullies between the keys to channel your pouring bodily fluids away.

Cherry Blue switches lurk beneath the keys, with a click that activates quite high up in the button's travel. It is, as we've come to expect, a positive action—there's no doubt whether you've pressed a key or not—and there's plenty of travel once you've pressed it. Whether you allow the key to bottom out or snap your finger straight back up again, it'll still register. There's six-key rollover with anti-ghosting (you can press six at once and it can distinguish them) for those finger-twisting combos.

MECHANICAL MINIMALIST

The steel-reinforced frame means it's a sturdy unit, its compact dimensions perhaps adding even more stiffness than a wider chassis would. There's little wobble in the keys themselves, just the tiniest movement if you rattle one about, and there are some decent feet under the keyboard, too, meaning it sticks, gecko-like, to your desk as you thrash from side to side. Extend the little feet that raise the back by about half an inch, however, and a disturbing degree of slippage creeps in. The feet are capped with hard plastic rather than grippy rubber, an oversight on the manufacturer's part, as the front rubber pads aren't enough on their own.

What you don't get are any programmable macro keys (boo) or Las Vegas-like lighting systems (yay), which means there's no application or special drivers to install before you can use it. It also keeps the desktop footprint small. Perhaps they could have gone further—Print Screen has its uses, but when did you last use Scroll Lock or Pause Break?

An FN button next to the right Alt key gives access to media controls found on the central F keys, and an indicator lamp on the F9 key lets you know when the Windows key lock is engaged, but that's about as complicated as it gets.

Unless you really need a number pad, this is a great mechanical keyboard. It may lack frills, but its build quality is excellent, it does the fundamentals well, and is a joy to use in a keyboard-intensive game. It's only $20 less than Corsair's K65 RGB though. How much do you like the colored lights? **–IAN EVENDEN**

VERDICT
8

Turtle Beach Impact 500

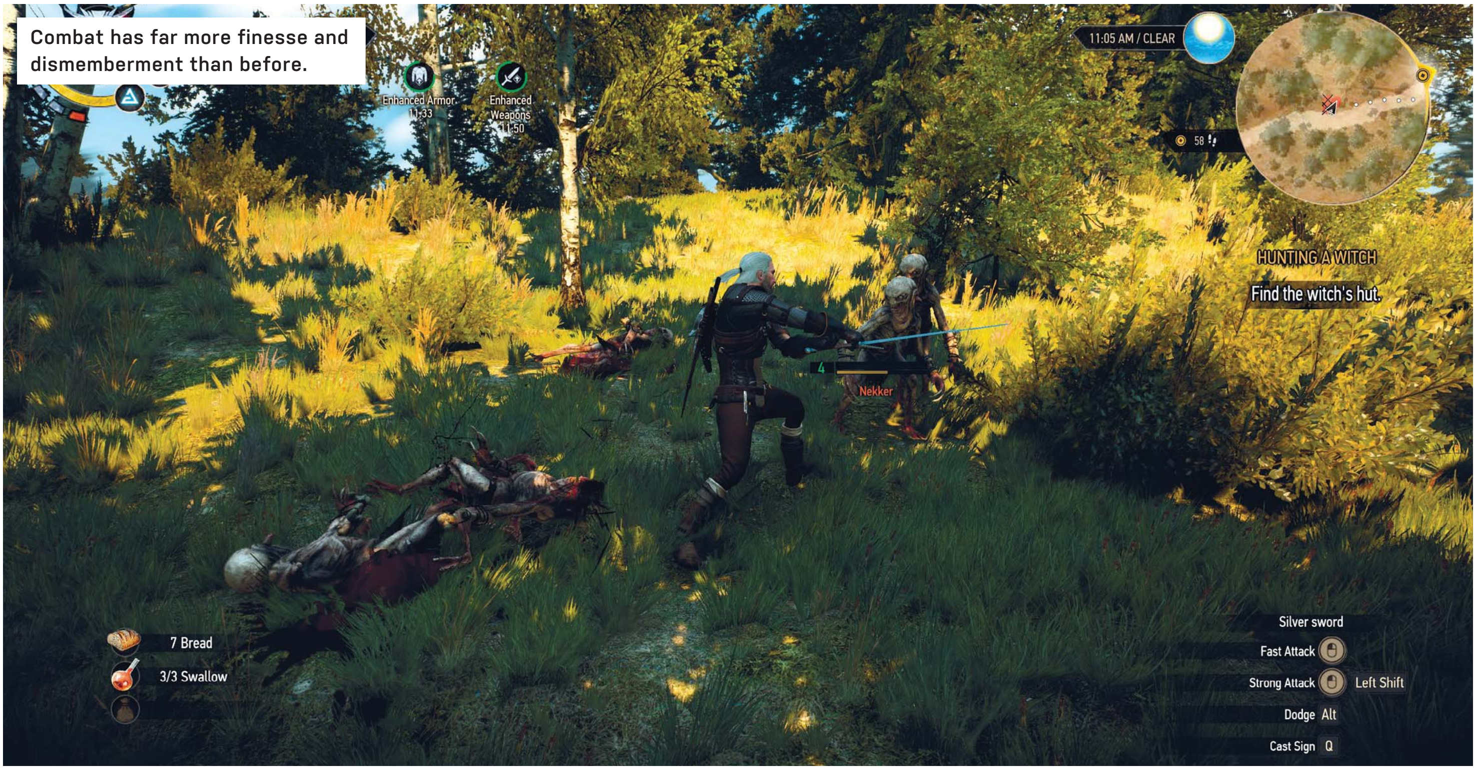
⊞ **IMPACT** Great build quality; lovely to use; nice clicky action.

⊟ **DETRACT** Wobbly on its feet; bit basic; a touch expensive.

$130, www.turtlebeach.com

SPECIFICATIONS

Switch Type	Cherry MX Blue
Cord	Detachable
Connector	USB
Anti-ghosting	Yes
Backlit	No
Keys	88
Rollover	Six keys



Combat has far more finesse and dismemberment than before.

The Witcher 3: Wild Hunt

One of the hairiest adventures ever. But the best?

IN MANY WAYS, *The Witcher 3* has that classic "difficult second album" feel, despite being the third in the franchise. The original game was a buggy, unremarkable RPG that surprised us by spawning an outstanding sequel. Few of us really expected *Assassins of Kings* to be the incredible game it was—it's not just one of our favorite RPGs, it's one of our favorite games.

So, *Wild Hunt* has a lot to live up to, but with most of the same team, a new game engine, and a huge scale, it could be the best fantasy adventure of this generation. But developer CD Projeckt Red is playing a dangerous game with *The Witcher 3*. It was only at 20-odd hours in that we were actually feeling it. It seems to be a case of the *Dragon Age: Inquisition* malaise, rather than the immediacy of *The Elder Scrolls*.

By that we mean it hadn't grabbed us by the balls and dragged us into its world until we'd already spent the best part of a full day immersed in the Northern Kingdoms. And, considering this world's seeming preoccupation with genitalia of either gender, that's something of a surprise.

The beginning is a slog. That shouldn't come as a massive surprise to anyone who played the previous games, but we truly thought, having made such progress with the second game's Enhanced Edition, CDPR would have made it a priority to nail the early exchanges of this vast RPG three-quel. You really do have to stick with it.

It feels a bit of a mess at the start. We spent a huge amount of time sat back in our chair, watching convoluted, seemingly endless, one-on-one exposition about a girl who was apparently our Burt Ward—who everybody seemed to know and fear, and yet we hadn't a frickin' clue about. A man shouldn't have to check out his own bestiary to figure out who his adopted daughter is.

I'M GERALT. YES, I DRINK

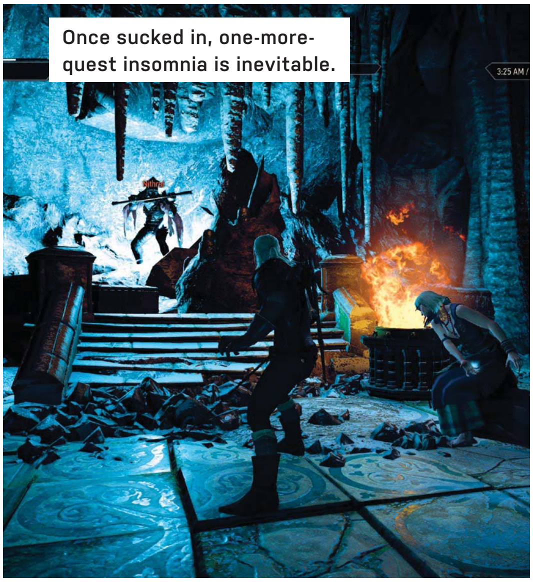
So, there we were, kicking our heels, waiting for it to be our turn to actually do something more than click a few dialog options. And when the time came, we realized we barely could. Check us out, we're Geralt of Rivia. We kicked some serious assmeat when the assassins and kings were duking it out last time around. We'd regained our legendary battle skills and notorious magical hoodoo—after a little forgetful interlude—and winded up using dragon bones for toothpicks. We were double-hard.

Now a couple of town guards can give us pause for thought (such as, "where did our left arm go? We're sure it was attached to that bloody stump...") because suddenly we're back to square one. No-one mentions the fact Geralt obviously suffered a major stroke at some point between the last two games, only now getting back to his fighting weight. At least in *Assassins of Kings* we had the handy amnesia subplot to explain away the RPG-necessity of leveling.

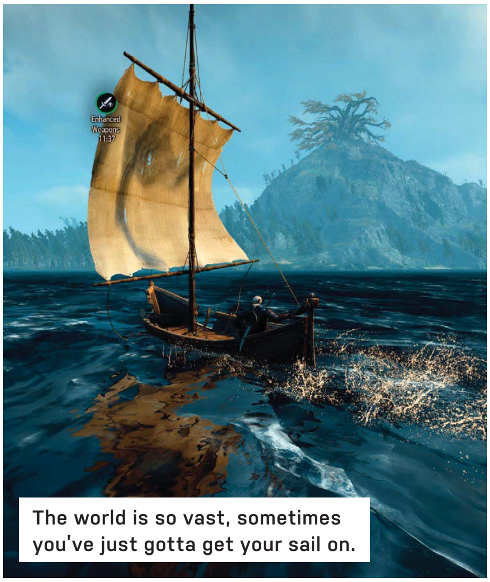
Then there's the sultry sorceress love-interest (no, not the redhead), we'd been relentlessly chasing in the previous game, who just casually appears out of nowhere in one of the biggest gaming anti-climaxes since *Colonial Marines* launched. "O hai, Geralt. Good to see you. Now go quest after some goat, horse about for a bit, and we'll catch up later," says Yennefer.

That was us for the first six hours. Gnashing teeth, whining about how the writing wasn't as good as *Assassins*, and cursing the continual teenage titillation of tessellated ta-tas. Then it seems to come to its senses. Or maybe we do.

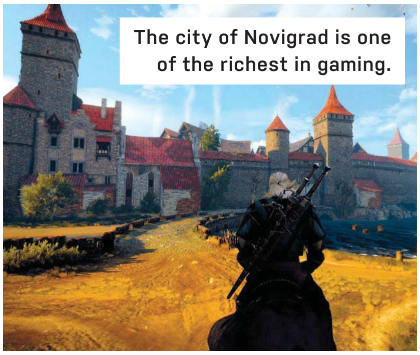
This isn't *Assassins of Kings*, it's a very different game. For all its branching storylines (it was the first game to make us replay just to check out the other side of the story), *The Witcher 2* is still quite linear. You follow the story, via a few quest-hub locations, to its conclusion. *Wild Hunt* has a very strong story thread, which thankfully finds its feet, but it's far more of an open-world adventure along the lines of *Skyrim*.



Once sucked in, one-more-quest insomnia is inevitable.

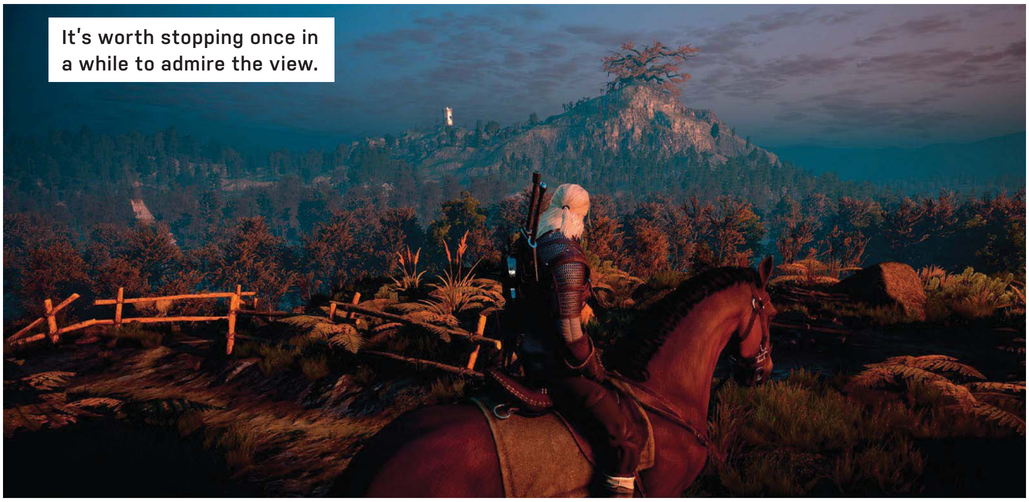


The world is so vast, sometimes you've just gotta get your sail on.



The city of Novigrad is one of the richest in gaming.

Geralt's all about the ladies.



It's worth stopping once in a while to admire the view.

What's killing the villagers? We've got an idea....

But there's less impetus from the plot to actually go out and explore. That's partly because you're a defined character, rather than the standard TES tabula rasa, but also because the story has such an urgency behind it that it feels like a betrayal to step off-track and go exploring.

It's so rich you'll end up with gut-ache from gorging yourself on it. Not to mention insomnia from the compulsive one-more-quest mentality it eventually engenders. It's a vast undertaking. The instant you open up the full map, packed with question marks begging to be answered, you'll find yourself lost in a bloody, engaging, often surprising, and satisfyingly tough game world. As much as you'll find the classic MMO-inspired Fedex missions and slaying heavy-going at times, you also get some really intriguing quests and storyline to play through, too.

Combat is a huge part of *Wild Hunt*, and much improved over *Assassins of Kings*. At once it's become easier and more rewarding, too. Especially as the increasingly compulsive leveling grind gathers pace. There's an impressive amount of finesse you can bring to battle too, with the ability to leap, dodge, and counter, and a little light mage-work for good measure. It's not quite at *Assassin's Creed* levels of buckled swash, but it makes for some seriously satisfying swordplay when you get it right. It's also the first RPG in which we've not leaped from our horse at the start of every fight. Mounted warfare in bullet-time ballet is actually enjoyable.

BAD HAIR DAYS

And it's mighty pretty. We weren't that taken with the visuals right at the start, but once you're in the wilds, the game becomes truly stunning. That all comes at a cost though, if you throw the settings right up.

At Ultra, our 4K Titan X rig struggled to maintain 30fps, and our R9 290X machine batted around 40fps at 1440p. And that's without Nvidia's suddenly controversial Hairworks getting involved. With it you're dropping a whole lot of perf for a little extra hairy fidelity. Though there is a lot of hair involved, including a dynamic facial fuzz system for Geralt, no less.

The Witcher 3 then recovers from a shaky start to become a rather excellent adventure (Wyld Stallyns!). It's definitely not perfect, but any RPG of this scope is going to have its share of face-palming "argh!" moments, and any *Witcher* game is certain to have its bugs. We've only scratched the surface of this world, but we're sure going to lose a lot more of our life to it. We just hope we don't have to chase down any more frickin' goats in the process. **–DAVE JAMES**

VERDICT
9

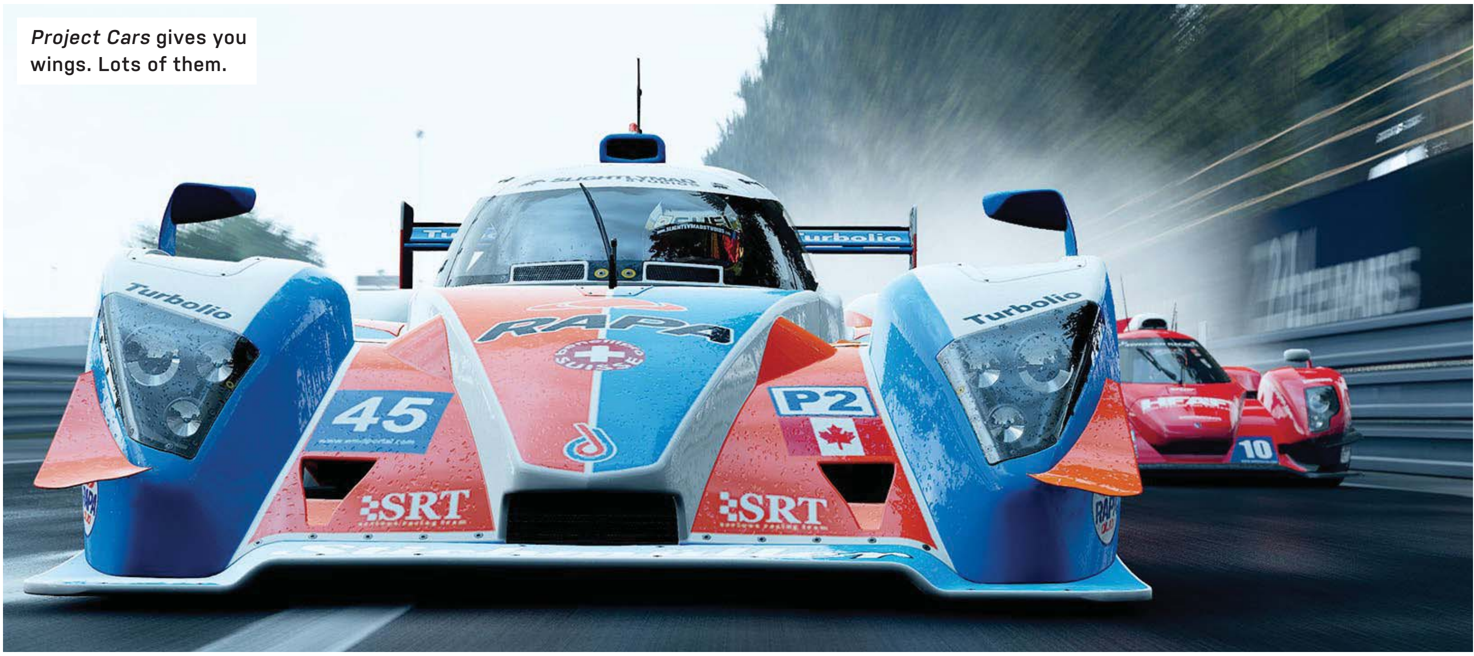
The Witcher 3: Wild Hunt

+ **BEWITCHED** Big. Really big; gorgeous; interesting, engaging combat and questing; open-world.

− **DERWOOD** Weak beginning; bunny sex; hard on the hardware if you push it.

RECOMMENDED SPECS Core i7/FX-8350; 8GB RAM; GTX 770/R9 290; 35GB storage.

$60, www.thewitcher.com, ESRB: M


Project Cars gives you wings. Lots of them.

Project Cars

Some say it's the greatest racing game ever...

ALL WE KNOW is that PC racing games have traditionally fallen into two camps. You could either have sexy visuals but dumbed-down realism courtesy of a typical *Grid* or *Need for Speed* instalment. Or, alternatively, the likes of *Live for Speed* or SimBin's *GTR* series, which would challenge driving talent, but be less concerned with taxing your graphics card.

The rich realism and jaw-dropping visuals offered by modern *Gran Turismo* and *Forza* incarnations haven't quite been matched by a single PC title, but *Project Cars* aims to change that. This is a game that strives for total realism, both dynamically and visually. It doesn't matter which of the 60-plus cars you choose—take it for a spin at dusk, with sun flares enabled and post-processing effects on full, and *Project Cars* looks absolutely sublime.

Stare at the ass-end of one of the game's classic cars and there's everything from individually modeled suspension wishbones to separate spark plug leads to drool over. Leaves rustle as you scream past, raindrops glisten on gleaming panels, and grass sways in the breeze. There's also realistic damage, with deformable body parts, plus the ability to scratch that pristine paintwork and crack windows. It's stunning stuff, though such a high polygon count and extensive shader use does put your GPU through its paces, especially when you're in a pack of other cars or driving in the rain, where the frame rate drops considerably.

Thankfully, all this polish hasn't been lavished on crap. Although the car list is nothing compared to *Gran Turismo* or *Forza*, it still features plenty of metal listed on any respectable wishlist. Gawp at track day weapons like the Ariel Atom V8, BAC Mono, and Caterham Superlight R500, through to hypercar exotica such as the McLaren P1, Pagani Huayra, and W Motors Lykan Hypersport. Lykan what? It's the car of choice for moving between skyscrapers in Abu Dhabi if you're Vin Diesel and have a thing against elevators.

The classic car scene is well catered for with retro BMW M3 and Mercedes 190E German touring cars, plus their spoiler and skirt-clad Ford Capri and BMW 320 Turbo predecessors, which do more to make the eighties look cool than KITT ever could. If open-wheel racing is your thing, you can try your hand at superkarts, 4-cylinder, and V8 formula cars, or even classic Formula 1 rides like the 1960's Lotus 49. There are no current F1 machines, however, and you won't find anything with a Ferrari or Lamborghini badge on it either.

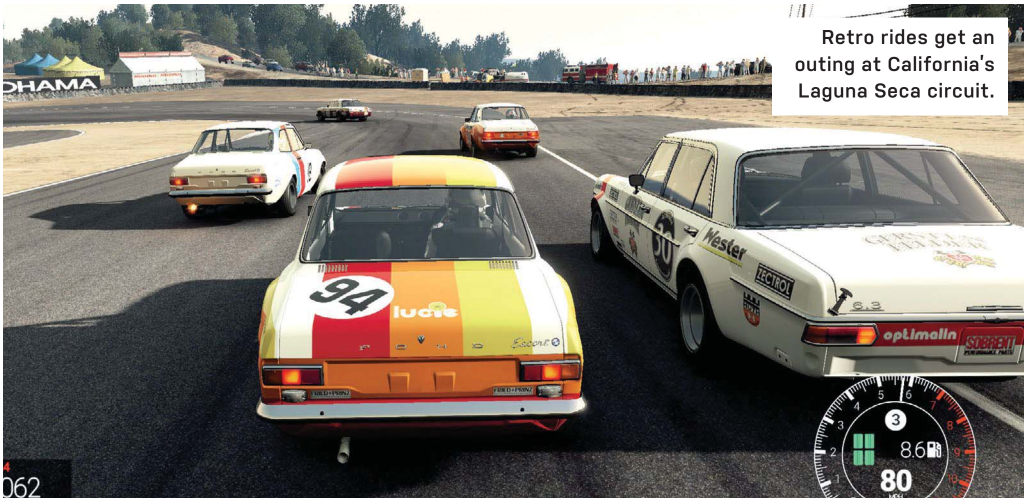
KEEPING TRACK

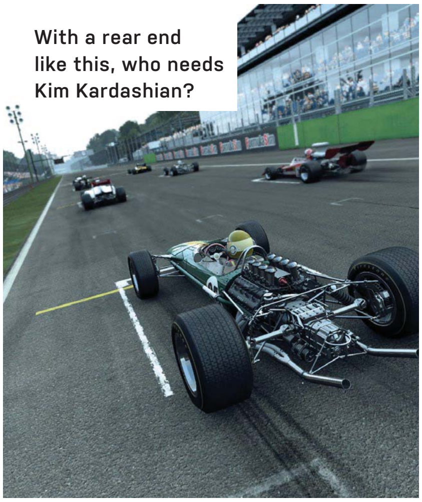
Track selection is almost uncompromising though. Think of pretty much any bucket list race track and it'll probably be here. Stateside circuits are well represented with Laguna Seca, Road America, and Willow Springs, while anyone who honed their virtual racing skills with the early *Toca* games will appreciate the inclusion of UK locations like Brands Hatch, Donington, and Oulton Park. But it's the truly iconic tracks that steal the show. Bathurst, Le Mans, Spa-Francorchamps, Imola, Monza, and that motoring mecca, the Nürburgring Nordschleife. Tissues please.

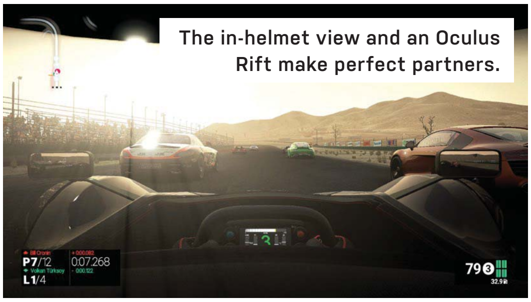
What's more, all the cars and tracks are drivable right from the get-go in Quick Race and Free Practice modes: no unlocking necessary. It's the same story in the slick online multiplayer mode, and there are community competitions to compete for fastest lap times and the prospect of prizes.

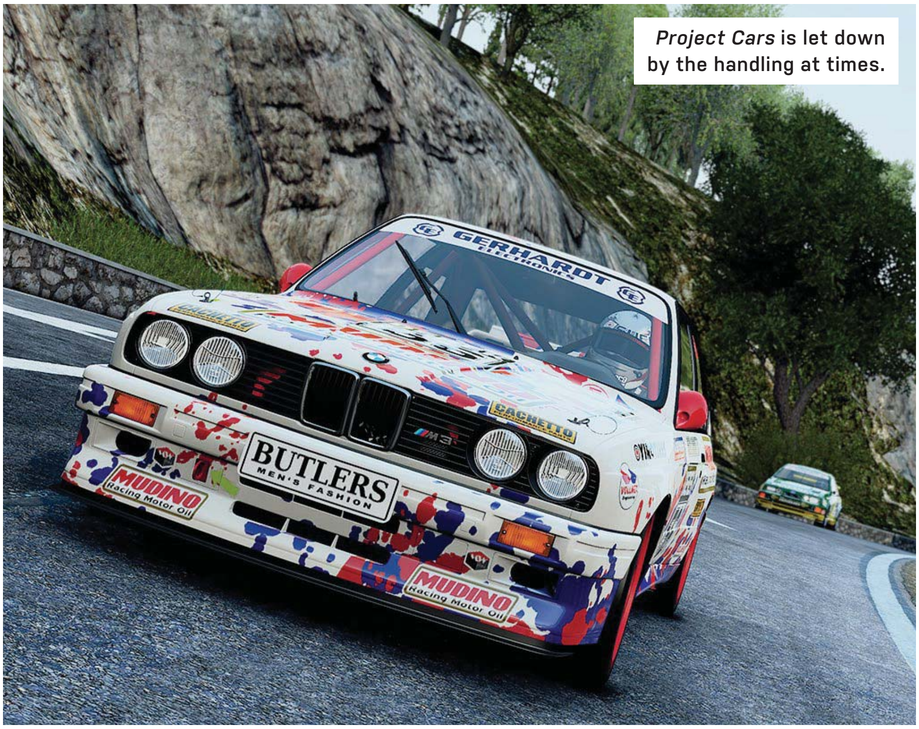
Those familiar with recent *Grid* titles will be at home in Career mode, where you choose between disciplines, including open wheel or touring cars, and progress through the ranks to reach an ultimate racing series. There are some clichéd frills along the way, like contract signing, corny emails, and faux fan tweets, but thankfully no contrived cutscenes to endure. Plus, even if you think you're the lovechild of Senna and the Stig, you can always dial down the AI skill and enable driving assists once you have a reality check and wish you'd stuck to *Mario Kart*.

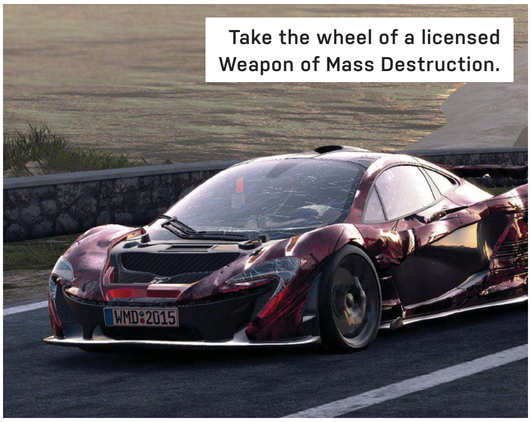
Yes, *Project Cars* is tough. It has to be to win over the sim racing crowd. These are car geeks who demand completely authentic handling characteristics, and who consequently look down on the *Need for Speed* series with more contempt than Ryan Gosling has for a tardy armed robber.


Retro rides get an outing at California's Laguna Seca circuit.


With a rear end like this, who needs Kim Kardashian?


The in-helmet view and an Oculus Rift make perfect partners.


Project Cars is let down by the handling at times.


Take the wheel of a licensed Weapon of Mass Destruction.

Trouble is, although it does come close, *Project Cars* isn't quite the last word in dynamic authenticity.

HARD TO HANDLE

Despite its bewildering array of vehicle setups and force feedback options, the cars simply don't handle as realistically or consistently as in other simulators, such as *Assetto Corsa*, *rFactor*, or *Simraceway*.

Take a Pagani Zonda R round the Imola circuit in *Assetto Corsa*, and its prestigious power will snap the tail out almost as quickly as the tyres lock up if you stamp on the brakes. Select the same car/track combo in *Project Cars* and it gives you the impression that ABS and traction control are enabled, even when they're not. It's a similar story with the *Project Cars* and *Simraceway* emulations of the Lotus 72 Formula 1 car, though this time it's Slightly Mad Studios' recreation that's much more of a handful, swapping ends under power with no warning in up to third gear. Few know how the real deal performs, but it's hard to imagine Emerson Fittipaldi tolerating such unpredictable handling back in the day.

If there's one constant in the physics department, it's that you don't feel quite as connected to the driving experience as you might want. This is partly down to those handling characteristics, but also the lackluster force feedback, which often fails to communicate basics like driving over a kerb, and generally leaves many cars feeling somewhat numb.

But these are relatively minor gripes only worth picking on because *Project Cars* sticks its balls on the line and professes to be "the most authentic racing game on the planet." While it falls marginally short, this is still one of the most polished examples of the genre for PC gamers, and strikes a compelling balance between style and substance. **–BEN ANDREWS**

VERDICT
8

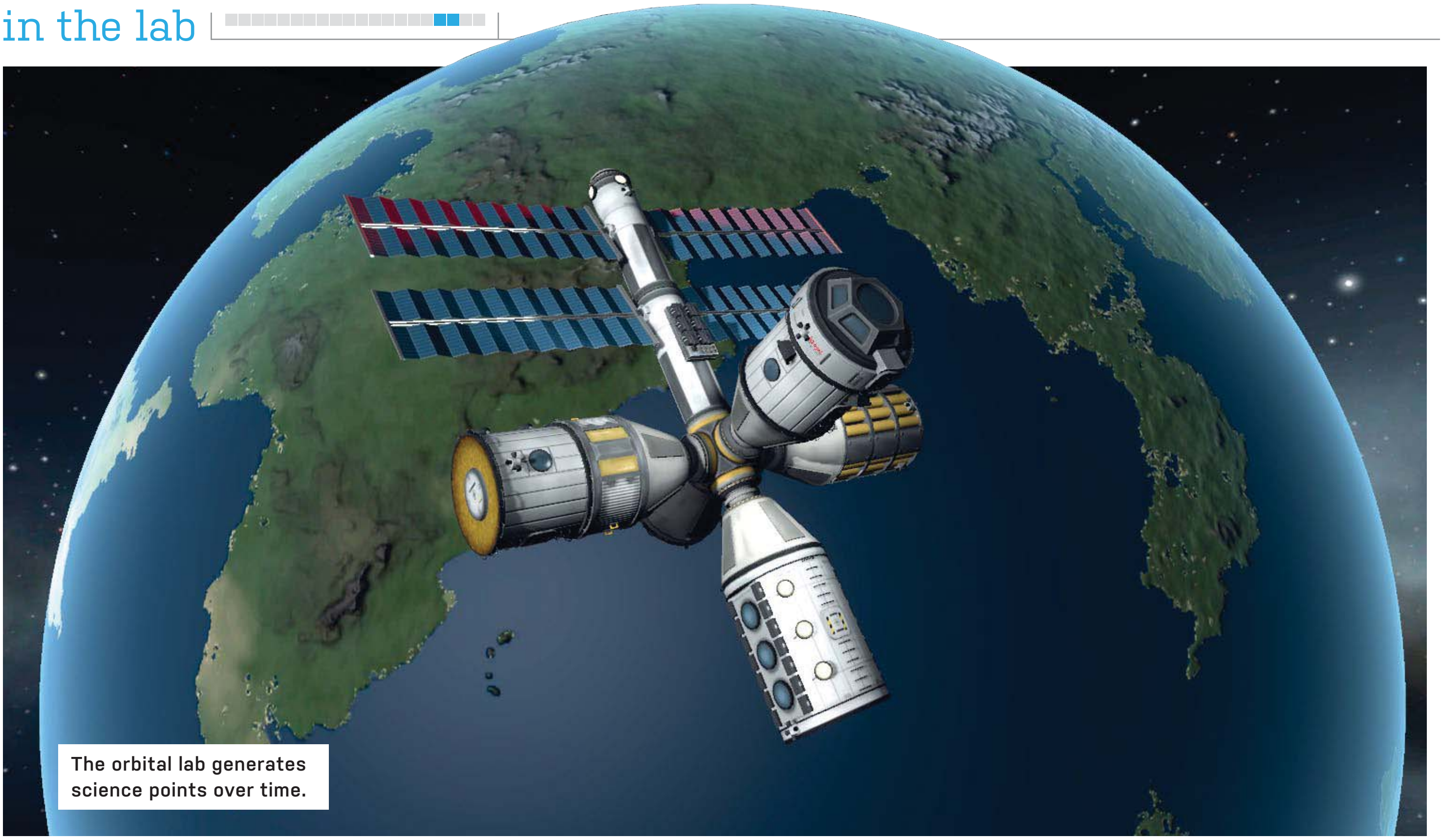
Project Cars

⊞ **SPEED** Stunning visuals; beautifully modeled cars; great track lineup; mostly realistic handling; decent career mode.

⊟ **SPEED 2** Uncommunicative force feedback; inconsistent handling characteristics; relatively restricted car selection.

RECOMMENDED SPECS Intel Core i7-3700/ AMD FX-8350; 8GB RAM; GTX 600 series/ AMD HD7000 series.

$50, www.projectcarsgame.com, ESRB: E



The orbital lab generates science points over time.

Kerbal Space Program 1.0

The little green astronauts achieve escape velocity

AFTER FOUR YEARS in open beta, there surely can't be anyone with even a passing interest in spaceflight who hasn't tried *Kerbal Space Program* yet. You drag and drop engines and fuel tanks to build a rocket, you strap strange little green dudes into the cockpit, and you fire them into orbit. But if you tried *KSP* a few versions ago and weren't hooked, or exhausted everything the early sandbox game had to offer, is version 1.0 worth a second look?

The big change is that the aerodynamic simulation has been vastly improved, to match the already realistic orbital physics. Gone is the infeasibly thick "soupmosphere" that required you to fly straight up for 10km and then pitch over 45 degrees to fly into orbit. Not only is the air thinner close to the ground now, the density varies with temperature as well as altitude, which means it's thinner over the Equator at midday and thicker during the night over the poles. Drag and lift properly account for how streamlined your rocket is, and the sound barrier feels like a real barrier you have to punch through. Fly too fast, too low, and you'll experience compression heating.

Theoretically, this means that your spacecraft can now burn up on re-entry, but the system is quite forgiving and catastrophe is only likely on the most extreme return trajectories.

To protect your delicate payloads from all this atmospheric buffeting, cargo bays and fairings have finally been added to the stock game. Fairings can be built to any shape in the editor and have an excellent "exploded view" feature that moves them out of the way so that you can continue to tweak the payload within. In flight, things are less satisfactory though. Fairings jettison in a shower of shrapnel, rather than two neat halves, and it's very difficult to make Apollo-style interstage fairings that behave correctly. They are also very heavy, and the physics engine treats the mass as being all in the fairing base, which remains behind after the fairings are jettisoned. For many designs, it can actually be more efficient to launch your payloads without fairings, which is a pity.

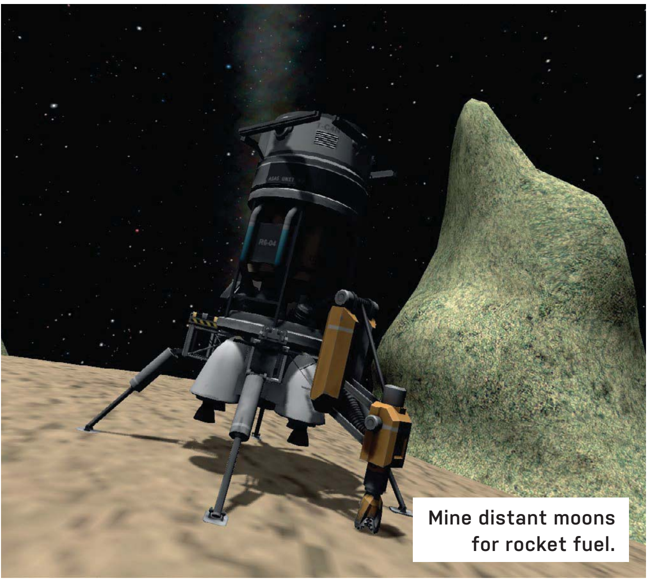
HARVEST TIME

The number of planets and moons in the solar system remains unchanged at 16 (though there are now asteroids in the orbit of Dres, as well as Kerbin) but there is a new reason to visit them: mining. Deposits of a nonspecific "ore" are now randomly generated for each save on each body.

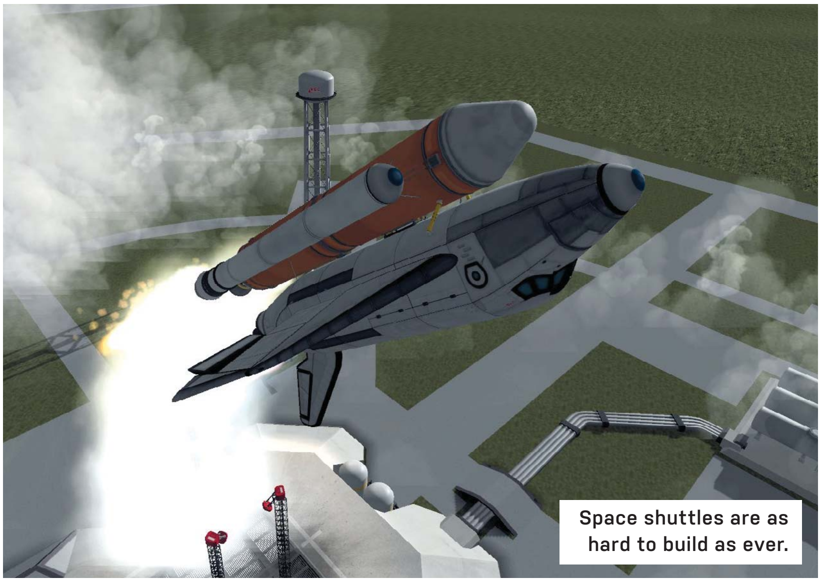
To harvest them, you must first use the new scanning antennae from orbit. Rather than scanning the surface in real-time, as you orbit above it (which just involves a lot of tedious messing about with time acceleration), the game simply requires you to place your scanner in the correct polar orbit. It then unlocks the whole resource map for that planet. The mining drill and ore refinery parts are bulky and heavy, so you can't just slap one onto every ship to give them infinite fuel, but off-world refueling stations are now a credible alternative to regular resupply missions from Kerbin.

Career mode has been in development for a few versions and the 1.0 release hasn't made any groundbreaking changes. The algorithm that generates random commercial contracts has been tweaked to eliminate the oddest ones and there are new mission types that require you to ferry space tourists, and establish bases and space stations.

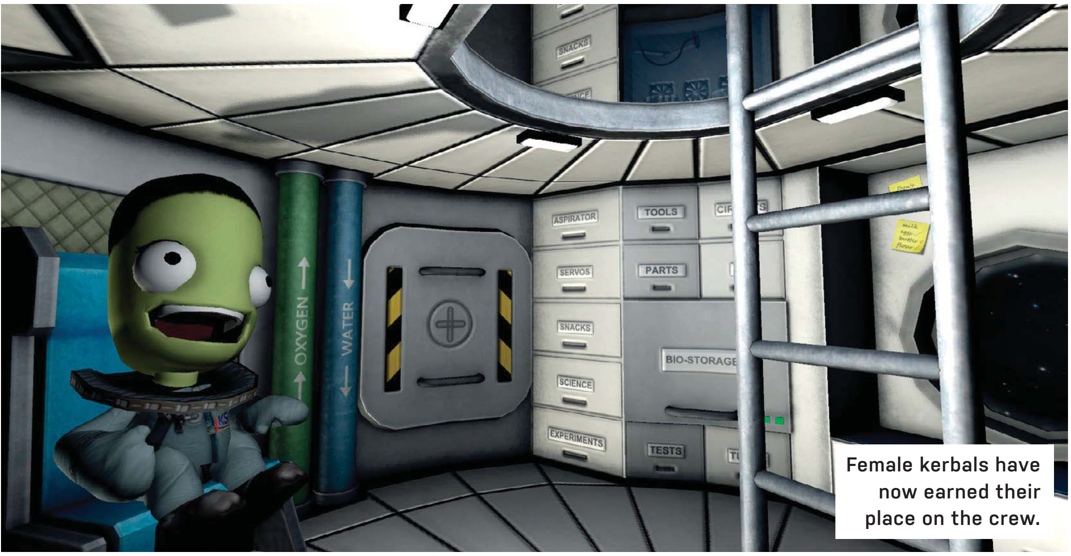
Rescue contracts aren't just a lone kerbal floating in his spacesuit anymore, but can involve a damaged cockpit or piece of debris, or a kerbal crash landed on a



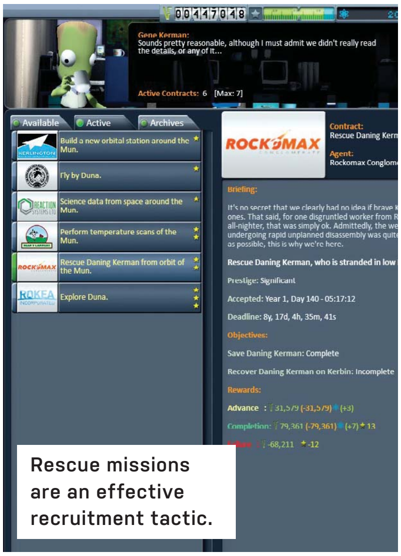
Mine distant moons for rocket fuel.



Space shuttles are as hard to build as ever.



Female kerbals have now earned their place on the crew.



Gene Kerman:
Sounds pretty reasonable, although I must admit we didn't really read the details, or any of it...

Active Contracts: 6 [Max: 7]

Build a new orbital station around the Mun.

Fly by Duna.

Science data from space around the Mun.

Perform temperature scans of the Mun.

Rescue Daning Kerman from orbit of the Mun.

Explore Duna.

Contract:
Rescue Daning Kerm

Agent:
Rockomax Conglom

Briefing:

It's no secret that we clearly had no idea if brave K
ones. That said, for one disgruntled worker from R
all-nighter, that was simply ok. Admittedly, the we
undergoing rapid unplanned disassembly was quite
as possible, this is why we're here.

Rescue Daning Kerman, who is stranded in low

Prestige: Significant

Accepted: Year 1, Day 140 - 05:17:12

Deadline: 8y, 17d, 4h, 35m, 41s

Objectives:

Save Daning Kerman: Complete

Recover Daning Kerman on Kerbin: Incomplete

Rewards:

Advance : 31,579 (-31,579) (+3)

Completion: 79,361 (-79,361) (+7) 13

-68,211 -12

Rescue missions are an effective recruitment tactic.

distant planet. Kerbals that you rescue get added to your crew roster, which can be very lucrative, since hiring new kerbals gets more expensive for each new recruit.

For all the new parts and improved systems though, *KSP 1.0* doesn't quite feel finished. You can still pull up the debug menu and tweak the "drag cube multiplier" or the "heat convection factor"—it's as if developer Squad still hasn't made up its mind about the best values. Orbital maneuvers, particularly interplanetary transfers, are still too frustrating to set up and adjust. There's nothing to tell you the thrust-to-weight ratio of your ship, or its delta-V, neither when you are building your rocket, nor when you are in flight.

These numbers are critical to success or failure in space, but the game leaves you to either eyeball them or break out the calculator and crunch the numbers yourself. Career mode also lacks purpose. You take on contracts to earn money, but money isn't especially useful. The space center building upgrades feel like they're just removing arbitrary restrictions. The tech tree gives you more parts as you unlock new nodes, but they aren't necessarily more advanced parts. You start with the smallest fuel tank, for example, and unlock larger ones, rather than beginning with a heavy primitive tank in several sizes and unlocking lighter, stronger ones.

MORE TO COME

And yet, for all that, *KSP* has dominated our game playing since we first downloaded version 0.16, so it's doing something right. The comparison is often made with *Minecraft*, and it's not just a business model that they share. Both are games without a storyline, without a victory condition.

KSP gives you a box of tools and a world of challenges and leaves you in charge of the rest. In fact, trying to "beat" the game is probably the least satisfying way to play. Everything new in 1.0 is an improvement and, for all the shortcomings that remain, you can download a mod to plug the gap.

Squad has made it clear that 1.0 is not the last update, just the latest. If you've already paid for one of the beta versions, you can download the release version for free and, if you haven't, it will probably be the best $40 you'll ever spend. **–LUIS VILLAZON**

VERDICT 8

Kerbal Space Program 1.0

+ LIFT-OFF Improved aerodynamics and re-entry heating; mine and refine fuel; fairings.

− CRASH LAND Career progression feels arbitrary; orbital maneuvers are tricky; no delta-V readout.

RECOMMENDED SPECS 2GHz dual-core CPU; 4GB RAM; 512MB graphics card, shader model 3.0.

$40, kerbalspaceprogram.com, ESRB: NR

LAB NOTES

JARRED WALTON **SENIOR EDITOR**

Back Up or Pay the Price

Your data is always at risk, SSDs don't change that

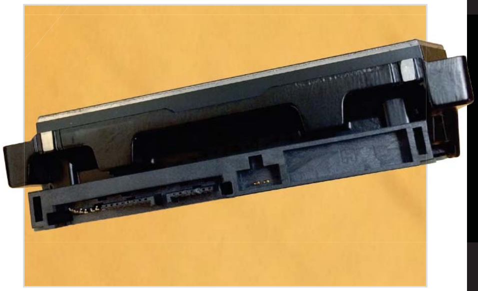
STICK WITH COMPUTERS long enough and it's bound to happen: a complete drive failure where all the data is effectively lost. Let's try a quick experiment.

Raise your hand. Put your hand down if you don't have a backup strategy, or if you haven't created a new backup in more than a week. Do you have offsite and onsite backups? If not, put your hand down. Finally, lower your hand if you haven't taken the time to test your backup during the past month.

If your hand is still up, go ahead and give yourself a pat on the back. Otherwise, hang your head in shame for a moment, and then take this opportunity to do something to change. Start by finding an online backup service, such as Amazon Cloud Drive, OneDrive, or Carbonite. Next, set up a local backup as well, like a USB enclosure, Windows Home Server, Linux rsync, or RAID 1. Once implemented, start testing both your local and online backups to ensure they're working properly.

With the increased use of solid-state drives instead of hard drives, the need for a good backup solution is greater than ever. There's a mistaken idea that SSDs are less likely than HDDs to fail, but I've personally seen three SSDs go kaput just this past year.

Data recovery experts can help in the event of a drive failure, but they make the yearly subscription rates for backup services look extremely reasonable. Recovery of data from a hard drive typically runs at $1,000–$2,000, while the increased complexities of SSDs mean recovery often costs twice as much. And data recovery of a recent SSD (in other words, newer than six months), or a drive with encryption, may not be possible at all.



A broken SATA connector: one of many ways a drive can die.

So, stay smart and make sure you have a backup solution now, before you need it. If you fail to protect your data, at some point in the next five years, you will likely either permanently lose important files, or you'll have to pay the piper his data recovery dues.

ALEX CAMPBELL

Associate Editor

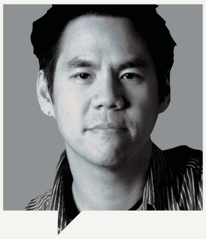
When we started the web version of "Blueprints," we were tasked with determining what benchmarks to use. It's no easy task to figure out what games and benches will be relevant in two or more years.

After many hours, I finally settled on a few that will hopefully be useful when new GPUs come down the pipe in 48 months. 3D Mark is challenging on Ultra, but it's still synthetic. For in-game benchmarks, I decided on *Bioshock: Infinite* at 1080p, *GTA V* at 1440p, and *Shadow of Mordor* at 4K. I considered both *Alien: Isolation* and *Wolfenstein: The New Order.*

Benchmarks are meant to be static, but hardware and software evolves. So benchmarks must also evolve.

JIMMY THANG

Online Managing Editor



PCs might have been around for decades, but crazy and cool new designs never cease to amaze me.

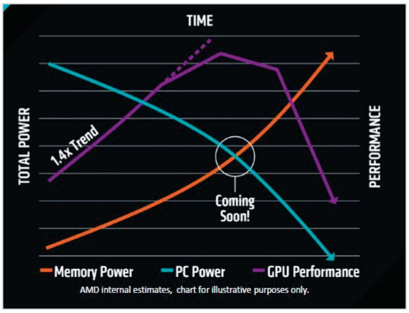
Right now, I'm sitting next to CyberPower PC's Trinity PC, which looks like something out of a Steven Spielberg sci-fi movie. And to my left is MSI's GT80 Titan, which is a gaming laptop with a fully integrated mechanical keyboard!

In comparison, we can see that cell phone designs have become surprisingly stagnant, despite them being a much newer creation. Alright, so maybe the new phone is 0.3 inches bigger. La dee da. I guess what I'm trying to say here is that I appreciate the restlessness that the PC industry has to offer, even after all these years.

First Look: AMD's High-Bandwidth Memory

A "revolutionary" solution to GDDR5 inefficiency?

GDDR5 WILL SOON stall GPU performance growth, says AMD, because, according to the red team, GDDR5 is entering an inefficient region of the power-to-performance curve.



GDDR5 will soon reach a performance bottleneck, claims AMD.

Historically, AMD would try and solve these power-to-performance issues by shrinking chips and integrating functions, but the company says that on-chip integration isn't ideal for DRAM, as DRAM is not size- or cost-effective for integration in a logic-optimized process.

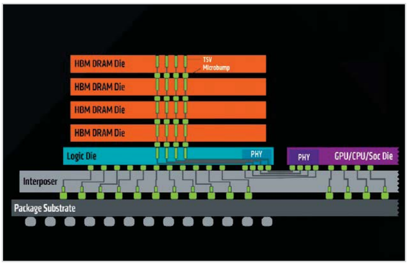
You could theoretically scale GDDR5 to be faster, but this requires more bandwidth and would consume more power.

AMD is attempting to solve these issues by introducing its interposer, which brings DRAM closer to the logic die. According to AMD, this closer proximity enables a much wider bus width, which also improves the bandwidth per watt as well. AMD says that bandwidth per watt is much more important than the sheer amount of RAM a graphics card has. And in case you were wondering, each stack here amounts to 1GB. So, if AMD's hypothetical next-gen GPU were to have 4GB of high-bandwidth memory, there would be four stacks.

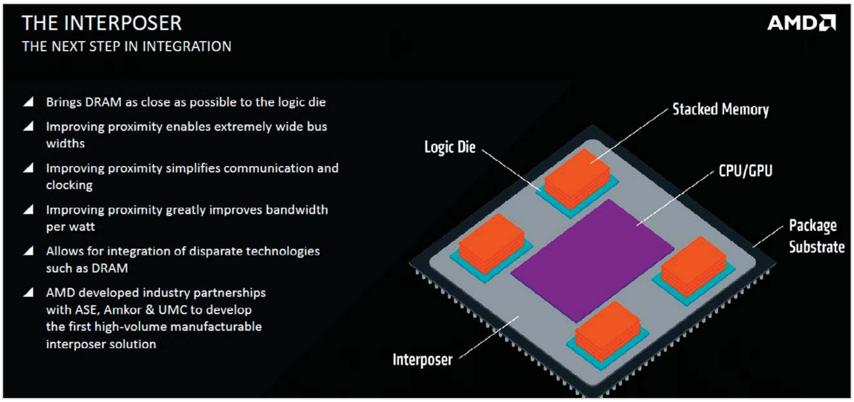
The benefit of using the interposer along with this high-bandwidth memory method is that it takes up much less surface area, and this combination gives you much more bandwidth than GDDR5, at less than 50 percent the power consumption.

While this will be applicable to discrete graphics cards, AMD believes it will also be able to leverage the technology to cover multiple verticals, including APUs, consumer applications, enterprise solutions, and more.

The company is calling HBM a "revolution in chip design" that will ultimately allow for up to three times the performance per watt compared to GDDR5, and will consume 94 percent less PCB surface than GDDR5. **–JT**



Here's the anatomy of AMD's new high-bandwidth memory stack.


THE INTERPOSER

THE NEXT STEP IN INTEGRATION

- Brings DRAM as close as possible to the logic die
- Improving proximity enables extremely wide bus widths
- Improving proximity simplifies communication and clocking
- Improving proximity greatly improves bandwidth per watt
- Allows for integration of disparate technologies such as DRAM
- AMD developed industry partnerships with ASE, Amkor & UMC to develop the first high-volume manufacturable interposer solution

Here's the layout for AMD's HBM interposer.

GEEK TESTED & NOT APPROVED

Razer Nabu X

UNLESS YOU'RE A GAME DEVELOPER or tech journalist, chances are you haven't gotten the chance to try on a virtual reality headset yet. VR is cool, but you'll have to wait a little while before you can be totally immersed in VR games; the first consumer models will hit the market later this year.

So, in the meantime, Razer has officially tossed its hat—or shall we say, wrist—into the wearable arena with its Razer Nabu X fitness band. While the company has a reputation for selling pricey products, its Nabu X is surprisingly affordable at $50. Along with tracking steps and how many calories you've burned, the Nabu X also syncs to your phone and acts as a notification band.

Here is where the Nabu X begins to disappoint, however. While the band offers a good amount of force feedback, it doesn't display any text. As a matter of fact, the only display indicators include three blinking LED lights. These LEDs display a wide variety of colors, but remembering what each combination of colors translates to can be confusing. Sure, you can open up Razer's fitness tracker app on your phone for a more in-depth readout, but there are similar fitness-tracking apps that don't require a band. All in all, we don't think the Nabu X is all that useful at this point. **–JT**

$50, www.razerzone.com

LETTERS

WE TACKLE TOUGH READER QUESTIONS ON...

> CPU and GPU Upgrade Paths
> Linux Drivers
> SLI Woes

CPU or GPU?

Currently, my build is an aging Core i7-980X with a GTX 670. I do some gaming, mostly FPS, and would benefit from an upgrade to a newer CPU. More and more, though, I find myself using VM and other non-gaming tasks. My dilemma is, would I benefit more from a better videocard or bite the bullet and get a new mobo and CPU, but maybe limit my VM and multi-use cases?

—Erick Smalley

EDITOR-IN-CHIEF TUAN NGUYEN RESPONDS: Hi, Erick. The Core i7-980X is still a very capable CPU, even by today's standards. If you're concerned about gaming, keeping the CPU and upgrading your GTX 670 would be a better move, as a good number of games are more GPU-bound than they are by the CPU.

If you're gaming less and are doing more productivity work, a newer CPU and motherboard will serve you well. If you want to make use of your current card, you could always try to find another used GTX 670 and run SLI, especially if you're trying to avoid having to spend a lot to overhaul your system completely.

Sharing the Love for Linux

I am excited in the direction you're taking with Linux. I've toyed around with several versions, but have never been able to successfully load Nvidia drivers. My last attempt with CentOS was unsuccessful. I would love to see how it is done.

—Bob Z.

EDITOR-IN-CHIEF TUAN NGUYEN RESPONDS: Bob, CentOS comes with its own drivers called Nouveau, which allow you to boot at high resolution and must be removed before installing Nvidia's Linux drivers.

To do this, you need to first use "yum" to update your system and build tools by using the following three commands:

```
yum update
yum install kernel-devel kernel-headers gcc make
yum –y upgrade kernel kernel-devel
```

Once you've completed these steps, you can use GRUB2 and add the following blacklist string to GRUB's options in /etc/default/grub:

```
rdblacklist=nouveau.
```

Once that's done, recreate the grub.cfg file by running:

```
grub2-mkconfig –o /boot/grub2/grub.cfg.
```

Reboot, enter runlevel 3 using the "init 3" command, install the Nvidia drivers, and then return to runlevel 5 using "init 5." CentOS should now be running with Nvidia drivers.

[NOW ONLINE]

A BRIEF HISTORY OF STEAM

When it comes to PC gaming, no distribution service is as big a powerhouse as Valve's Steam platform, which boasts some 125 million regular users. However, it wasn't always all sunshine and roses for Steam. Indeed, the service was once viewed as very invasive DRM. Oh, how the times have changed!

Now, the platform offers nearly 4,500 games and tons of services that include chat, friends lists, cloud saves, mod support, and more.

Check out our online story to see how Steam started off from humble beginnings and why it's grown into the gaming giant it's become today. http://bit.ly/1JYNHM4

Steam has come a long, long way since starting in 2002.

↘ submit your questions to: comments@maximumpc.com

Spurning the Love for Linux

I am happy to see that we will benefit from some qualified Linux coverage. Now, for the awkward part: It was all too much. Few of us give a rat's ass about terminal commands nowadays. We've been there and done that and have no desire to go back in time. If you can't explain how to do anything in Linux without invoking the stupid Terminal window and typing arcane commands, then I'm not interested.

—Darth Digital

EDITOR-IN-CHIEF TUAN NGUYEN RESPONDS: Darth, not everyone has mastered the force of Terminal as well as you, and some prefer to use Linux for its powerful terminal. Yes, Linux has come a long way in becoming an excellent GUI OS, but there are some tasks that are done faster in the Terminal. Take a wedged system, for instance, where the GUI has locked, but the OS is still responsive.

If you knew your Linux commands and had SSHD enabled, you could SSH into the system and kill an offending process or restart the Window server. This is just one scenario. We believe that covering Linux from as many bases as possible will hopefully give a more complete and rounded experience.

> “FEW OF US GIVE A RAT'S ASS ABOUT TERMINAL COMMANDS NOWADAYS. WE'VE BEEN THERE AND DONE THAT.

Keeping on Track

I enjoyed the recent gaming mouse roundup, but I have always preferred a trackball. How come I never see them reviewed?

—Jack Perry

EDITOR-IN-CHIEF TUAN NGUYEN RESPONDS: Jack, that's an interesting article idea, we'll consider it! However, the majority of users are accustomed to using a mouse, and most companies only produce mice. Choice is distinctly lacking in the trackball category. But, from our experience, Logitech still makes excellent trackball devices. If you're really in a hurry for a good trackball, we would recommend Logitech's Wireless Trackball M570.

Game over?

Whenever an operating system upgrade comes along, we're forced to give up some of our favorite games. Would it be possible to include the effect on our games when reviewing a new operating system?

—Raymond Peterson

EDITOR-IN-CHIEF TUAN NGUYEN RESPONDS: Hi, Raymond. Indeed this can be an issue, but it would be impossible to run through every popular game every time Microsoft decides to release a new version of Windows. But you do have options. Windows comes with a built-in compatibility feature that allows you to select which version of Windows you would like a program to run in. If you right-click a program shortcut, you can select different OS versions under the Compatibility tab. This has worked well for some games. For others, you might want to look through www.gog.com. It has a huge list detailing the games that have been made compatible with the latest versions of Windows.

Bridge Over Troubled SLI

I got two EVGA GTX 980s for my system. My primary graphics use is *Far Cry 4*, and I have been dogged with issues. My main complaint is a red tinting, and there can also be severe image flickering. Disabling SLI makes the problem go away, and I've tried four separate SLI bridges, but that defeats the purpose of a second 980 because I also have a 30-inch screen. Help!

—Chris Ajemian

EDITOR-IN-CHIEF TUAN NGUYEN RESPONDS: Chris, that is indeed a headache, and one that would make us spill our lunch. Interestingly, when we did our three-way Titan X tests, we had tons of similar problems. We actually went through multiple different SLI bridges before we came across one that solved the problem. Have you tried playing around with both ribbon and PCB bridges? You may find that one works while the other doesn't.

Facebook Polls

King of the Mods

This month, we asked our Facebook group what they think is hands-down the most important game mod of all time. Here are some of our favorite responses.

Ryan Neal Nye: *Counter-Strike*. It generated the popularity for Valve that led to *Half-Life 2*, and more importantly, Steam. Without *CS* there probably would not be a Steam today.

Chris Fisk: *Team Fortress*. It gave us the first headshot and ushered in the whole "class-based" shooter genre.

Michael Flynn: *Starcraft*'s map editor led to some amazing games outside of the game.

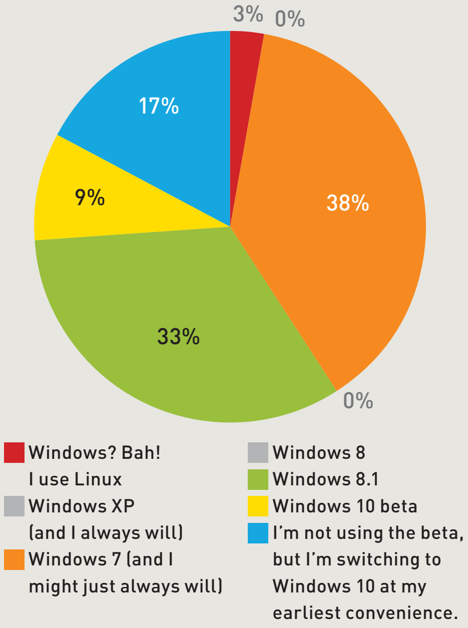
Jess Krause: *Desert Combat* for *Battlefield 1942*. It raised all of my expectations of what a mod was supposed to do, and influenced the sequel and I believe the later *Call of Duty* games. Great memories from that one.

Craig Brucker: *Garry's Mod*. It paved the way for average players to start messing with SDKs and making maps. Think of how many designers started out with *Garry's Mod*.

Kacey Spiker: *Skyrim: Thief Player Home in Riften Canal*. There is nothing more satisfying than coming home and sorting out 500 pounds of crap into OCD labeled containers.

Martin Monnard: *Counter-Strike*, because it was made more than 16 years ago and is still 15th on Steam's most-played games today!

Which version of Windows do you use?



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THE BUILDS

BUDGET GAMER

INGREDIENTS

PART			PRICE
Case	NZXT Source 210 Elite		$50
PSU	Corsair CX500M 500W		$55
Mobo	Gigabyte GA-Z97-HD3 (R2)	**NEW**	$100
CPU	Intel Core i3-4150		$123
GPU	MSI GTX 960 GAMING 4G GeForce GTX 960	**NEW**	$240
RAM	2x 4GB Crucial Ballistix Sport DDR3/1600		$57
SSD	240GB SanDisk Ultra II		$100
HDD	Seagate Barracuda 2TB	**NEW**	$77
OS	Ubuntu Desktop Linux 14.04 LTS 64-bit	**NEW**	$16

Approximate Price: $818

WE DECIDED TO UPGRADE to a Z97 board to serve as the i3's new home, allowing for overclocking if the CPU is upgraded later. The build crept closer to $900, so we did the unthinkable and dumped Windows 8.1 for Ubuntu Linux 14.04 LTS (gasp!). You can get Ubuntu for nothing, but we set the price at Ubuntu's recommended donation. We put some freed-up cash toward doubling the HDD storage to 2TB. We dropped in a GTX 960 instead of the R9 285 to provide a base system ripe for upgradability, and to make it more Linux-friendly. If Steam's selection of Linux games isn't enough, drop back down to a 1TB HDD and pick up a copy of Windows 8.1 for a total cost of $877.

MIDRANGE

INGREDIENTS

PART			PRICE
Case	Corsair Vengeance C70		$110
PSU	EVGA SuperNOVA G2 850W	**NEW**	$143
Mobo	Asus Z97-A/USB 3.1		$160
CPU	Intel Core i5-4690K		$215
Cooler	Corsair H100i GT		$95
GPU	XFX Radeon R9 290 Double Dissipation		$270
RAM	2x 4GB Crucial Ballistix Sport DDR3/1600		$57
Optical Drive	Samsung SH-224DB/BEBE		$20
SSD	2x Mushkin Enhanced ECO2 120GB	**NEW**	$110
HDD	Seagate Barracuda 3TB ST3000DM001		$100
OS	Windows 8.1 64-bit OEM		$100

Approximate Price: $1,380

THE RISE IN PRICE on the Corsair RM 850W power supply made us switch our choice over to EVGA's SuperNOVA 850W PSU. This EVGA unit is modular like the Corsair, but boasts a 10-year warranty. That means when you upgrade your PC down the road, you can keep using the same PSU without worry. For storage, we went with a pair of 120GB Mushkin ECO2 SSDs. We made up for the slightly lower performance of the SSDs by putting them in RAID 0, which nets reads and writes that leave a single drive in the dust. The Mushkin's mean time before failure is a quarter of a million hours more than the SanDisk. RAID 0 will also halve the hits on writes on each drive.

TURBO

THE FIRST THING WE DID to the Turbo build this month was swap out the single 1TB 850 EVO in favor of two 500GB models. We did this for two reasons: The 1TB drive jumped up $10 in price to $400, and the 500GB drives were priced at $200. Second, using RAID 0, you'll see a big jump in read speeds. Write speeds will be increased too, but will fall off once the cache fills up for really long sequential writes. You can choose resiliency with RAID 1, as well. If you don't want to bother with RAID, we'd recommend sticking with the 1TB drive, since there's no difference in price and cable management is always neater with fewer drives. The price on the XFX R9 295X2 went up, so we switched to Sapphire's implementation. While the price is $20 higher than the listing of $600 last month, there was a $20 mail-in rebate that made the price effectively $600 again.

For more of our component recommendations, visit www.maximumpc.com/best-of-the-best.

INGREDIENTS

PART			PRICE
Case	Corsair Graphite 780T		$180
PSU	EVGA SuperNOVA G2 1,600W		$340
Mobo	Asus X99-PRO/USB 3.1		$320
CPU	Intel Core i7-5820K		$390
Cooler	Cooler Master Nepton 280L		$120
GPU	Sapphire Radeon R9 295X2	**NEW**	$620
RAM	4x 4GB Corsair Vengeance LPX DDR4/2400		$180
Optical Drive	LG Blu-ray Burner WH16NS40		$67
SSD	2x 500GB Samsung 850 EVO	**NEW**	$400
HDD	Seagate Barracuda 3TB ST3000DM001		$100
OS	Windows 8.1 64-bit OEM		$100

Approximate Price: $2,817

UPGRADE OF THE MONTH

KINGSTON HYPERX CLOUD II

With an aluminum-and-vinyl construction, these comfy cans omit the plastic in the headband that makes many headsets feel flimsy. The simulated 7.1 surround keeps you ducking in a firefight. The detachable mic and volume control mean you can wear these as casual stereo headphones as well.

$100, www.kingston.com

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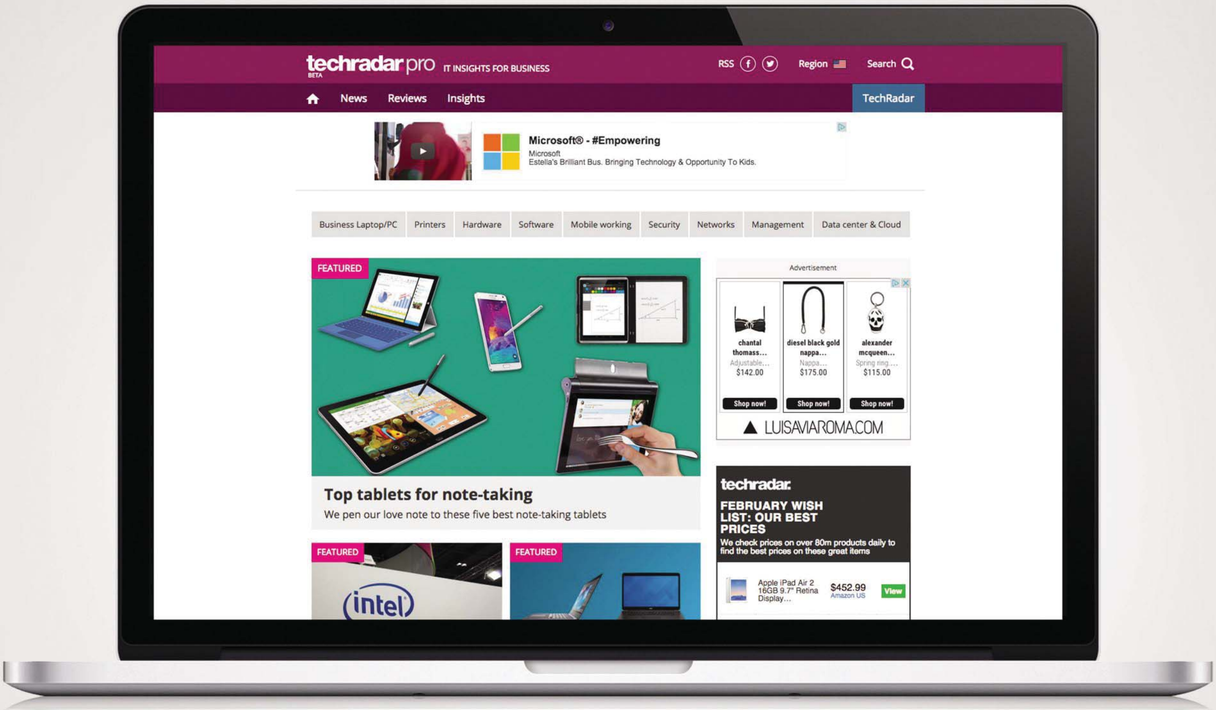
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